PUBLIC WORKS

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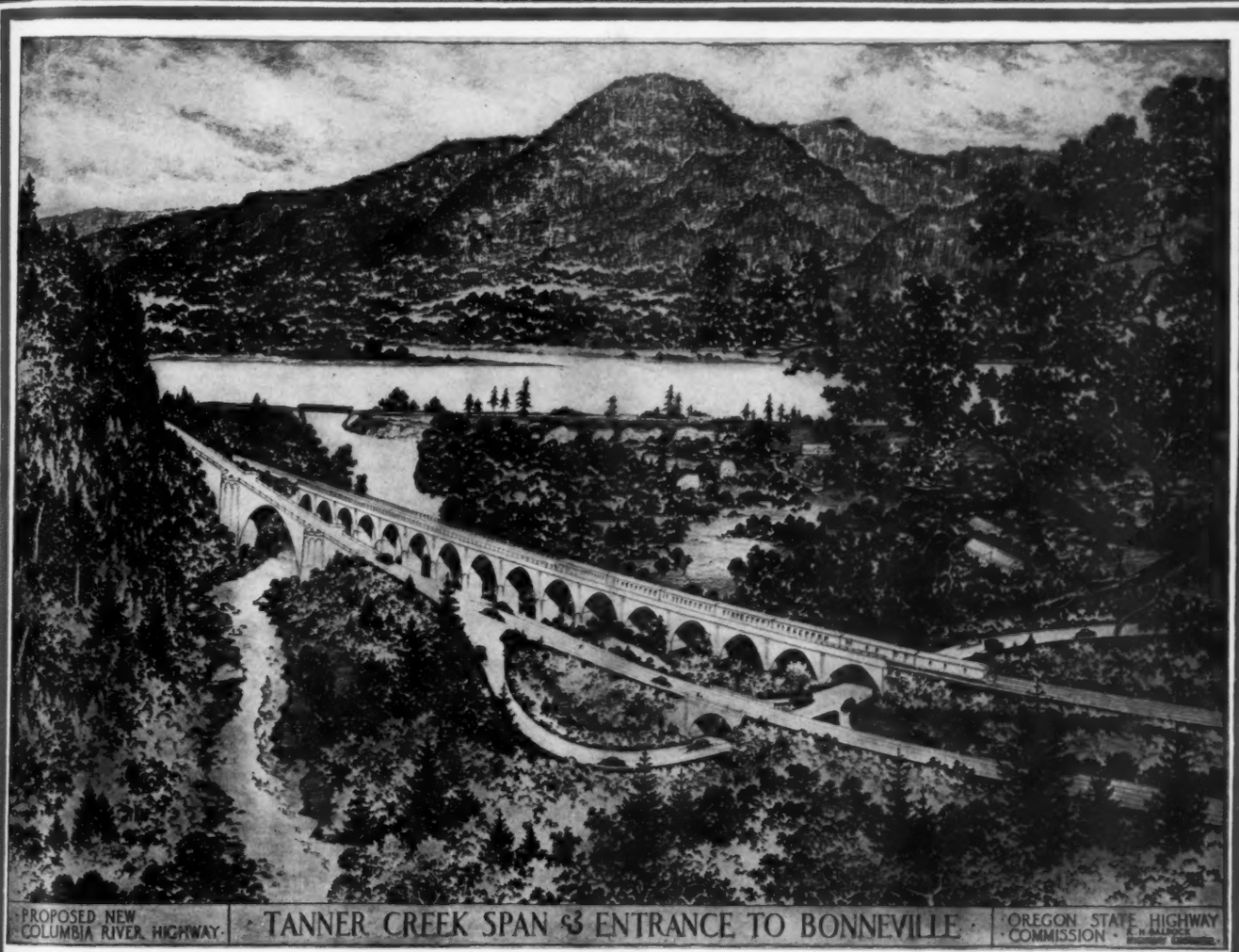
City, County and State



THIS sketch of the entrance to the Bonneville Dam project on the Columbia River in Oregon, shows not only the partial cloverleaf grade separation, but also faithfully portrays the scenery along the Columbia River Highway. Some further data will be found on page 19 of this issue.

APRIL, 1936

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City, County and State Engineering and Construction

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TIMEWASTERS:

WHAT with thoughts of fishing, raking the leaves off the home lot, and all the other spring-time duties, it is hard to concentrate on Timewasters; in fact, we are a bit behind. But here are a few to keep everyone in trim.

A Sea-Faring Problem:

A ship is twice as old as its boiler was when the ship was as old as the boiler is now. If the sum of their ages is 21, find the age of each. Contributed by *John A. Bevan.*

5, 5, 5, 5:

The "3" problem of last month was a pretty good one; try it now with 5's and see how far you can go. Ye editor got along pretty well on this one, as far as 28, but he can't make the grade on 17 and 18. Advice and assistance appreciated.

7, 7, 7, 7:

And while you are on the subject, the "7" problem is just as interesting and just as tough—maybe more so. All in all, these number problems permit the wasting of a lot of time, without accomplishing any tangible results in making more money, which is the purpose of TIMEWASTERS.

The Flagpole:

Last month we had a problem from Mr. Kalhoefer, down in Medford, Oklahoma, which was a pretty good one. Due to the distractions already mentioned in the first paragraph, we have not worked it out, but two readers did—Lt. Cron and Mr. Winter. They both agree that the flagpole is 196.14 feet high. And so does Mr. Blunk of Indiana. Thank you, gentlemen.

The Dead Ends:

This problem dated back to February. Mr. Smith of Washington has sent us a solution—the only one to date—but he finds it necessary to run one of the lines under one of the houses. That's better than we did; after wasting half a day, we gave up. Any more?

P. S. Since writing this, C. E. Keefer has contributed his version.

The Poker Players:

That problem of the poker players and cigarette smokers was a good one, and required some smart stepping. We believe that there is perhaps more than one solution. Lt. Cron sent in one which agrees with our own, as follows: Brown had 3 OG's; Turner 6 Kools; Perkins 15 Chesterfields; Reilly 8 Camels; and Jones 20 Luckies.

More contributions gratefully received. W. A. H.

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A. PRESCOTT FOLWELL, Editor — **W. A. HARDENBERGH,** Asso. Editor

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PUBLIC WORKS

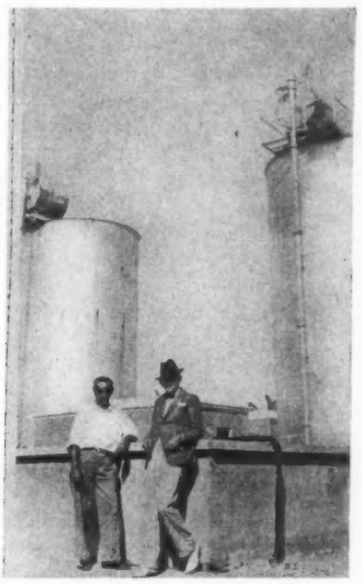
City, County and State Engineering and Construction

Vol. 67 — *April, 1936* — No. 4

The Water Supply of Nassau, Bahamas

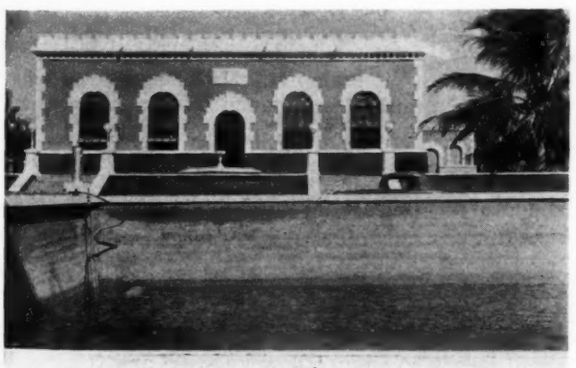
By Geo. L. Robinson

Consulting Engineer, New York City



Water softening plant; collecting reservoir in foreground.

THROUGH the courtesy of Captain John F. Holmes, of the Department of Public Works of Nassau, on the Island of New Providence, Bahamas, the writer recently was given an opportunity to study the manner in which they had solved a difficult water supply problem, which may offer suggestions for solving similar problems elsewhere.



Top—Power house. Chlorinating pipe in reservoir. Bottom—Covered screen chamber, showing pipe and blower for removing gas.

The island is about 20 miles long by 10 wide, made up of a somewhat porous calcareous limestone, with very little top soil anywhere in the island. Extending east and west near the northern shore is a ridge of hills, and the city of Nassau is located on the northern slope of these, extending from the water front to the crest of the hill, a distance of perhaps three-quarters of a mile. South of the hills is a flat country, in which are some brackish ponds, containing quite a dense growth of scrub bushes and very small trees, but there is not enough top soil to support a forest.

Until 1929 the city and surrounding country depended for their water supply upon shallow wells, the water from which was somewhat saline. But trade with the United States developed such prosperity that the city decided it could afford a water supply and sewage treatment plant.

Borings and ground water analysis showed that there was a zone of fresh water floating on the salt water about 30 feet below the surface of the ground, which was derived from rain water that percolated through the limestone. A distinct tidal variation in this water, due to the influence of ocean tides was observed. This fresh water zone is not over 4 feet thick. The rock here is said to contain about 12 or 14 pounds of water per cubic foot. In order to remove fresh water from this zone without drawing in any of the salt a large number of wells—approximately 125—were driven in a watershed on the south slope of the hills, about 3 miles from the city. The maximum daily supply, when winter tourists bring the population up to 10,000, is about 500,000 gallons, which is drawn from about 75 per cent of the wells, or about 5,000 gallons per well per

day. Care is necessary to prevent overdrawing any one group of wells and so introducing salt water, and frequent tests for salinity are made of the yield of each well.

A power house located here contains pumps and air compressors for operating air lifts; in addition to which windmills have been erected over the well points, and the water is raised by these when the wind permits. The water is discharged into a pipe system laid above ground, in which it runs by gravity to a central concrete collecting well, divided into two parts, with a capacity of 100,000 gallons.

Quality of Water

The water is extremely hard, due to the limestone rock through which it passes, and also is subject to rapid formation of algae, and is softened by the lime-soda process. The softening plant consists of two steel tanks approximately 35 feet high, which treat the water at the rate of 10,000 gallons per hour each. The lime and soda are introduced by an automatically operating measuring device. The precipitated matter which does not settle out is removed by passing through a filter 2 feet thick, and the effluent overflows into two 50,000-gallon concrete tanks. Before being pumped it is chlorinated the dosage being about one-fourth part per million, as a precautionary measure; occasional bacteriological analysis give no evidence of the presence of B. Coli. There is no taste in the tap water. From here the water is pumped three miles to Fort Fincastle reservoir.

The power house is a handsome structure of modern design, appropriate to the semi-tropical surroundings. The pumps operate under 125-lb. pressure through a 12-in. force main. To insure continuous service, the plant is in duplicate—two compressors, two pumps with motors and diesel engine reserves. The level of water in the reservoir is indicated automatically in the power house.

The reservoir, which is on the top of the hill within city limits, has a capacity of 40,000 gallons and supplies the lower part of the town. Adjacent to it is a concrete tower supporting an 85,000-gallon reinforced concrete tank, which supplies the high level. The tower is 126 feet high and the base of the tank is 216 feet above sea level. Around the tower is an observation platform, from which ships are visible for more than 18 miles. An elevator shaft passes through the center of the tank, which thus has an inside as well as outside supporting wall. There is no evidence of cracking, moisture or disintegration on any part of the structure, which is very pleasing in architectural appearance.

At this reservoir there is an hydraulic ram which receives water from the low-level pumping station and lifts the day's supply to the high-level tank. Tank and tower are so cross-connected and valved that in case of fire the entire supply can be called upon. The details of piping, valves, etc., are very much the same as are found in small-city plants in this country, but are of English manufacture—heavy, durable and somewhat more rugged than most American-made equipment.

Because of the increasing popularity of Nassau as a resort, definite steps are being taken to increase the capacity of the reservoir and distribution system. The mains are extended from time to time to supply more of the negro population, which lives on the south slope of the hills, which are served through street taps.

The low per capita consumption is accounted for by the fact that the people live largely in the open, little or no sprinkling is required, there are no manufacturing plants, and domestic consumption is centered in the better part of the town.

The sewer system covers a considerable area of the more densely populated portions of the city. The sewage flow, with some infiltration of salt water, is about 400,000 gallons per day, and is collected at a point on the northern water front and carried in a 36-inch pipe across some 1,000 feet of bay to a small island, where it is treated in an activated sludge plant.

Sewage Treatment

At the plant the sewage is lifted by one or two electrically operated centrifugal pumps to a screening chamber, and from this flows to primary tanks, thence to the secondary tank and the final settling tank. The effluent is quite clear, and there is no sewage fungus or other evidence of sewage pollution on the rocks, and no odor. The surplus sludge is drawn off at intervals onto a sand bed.

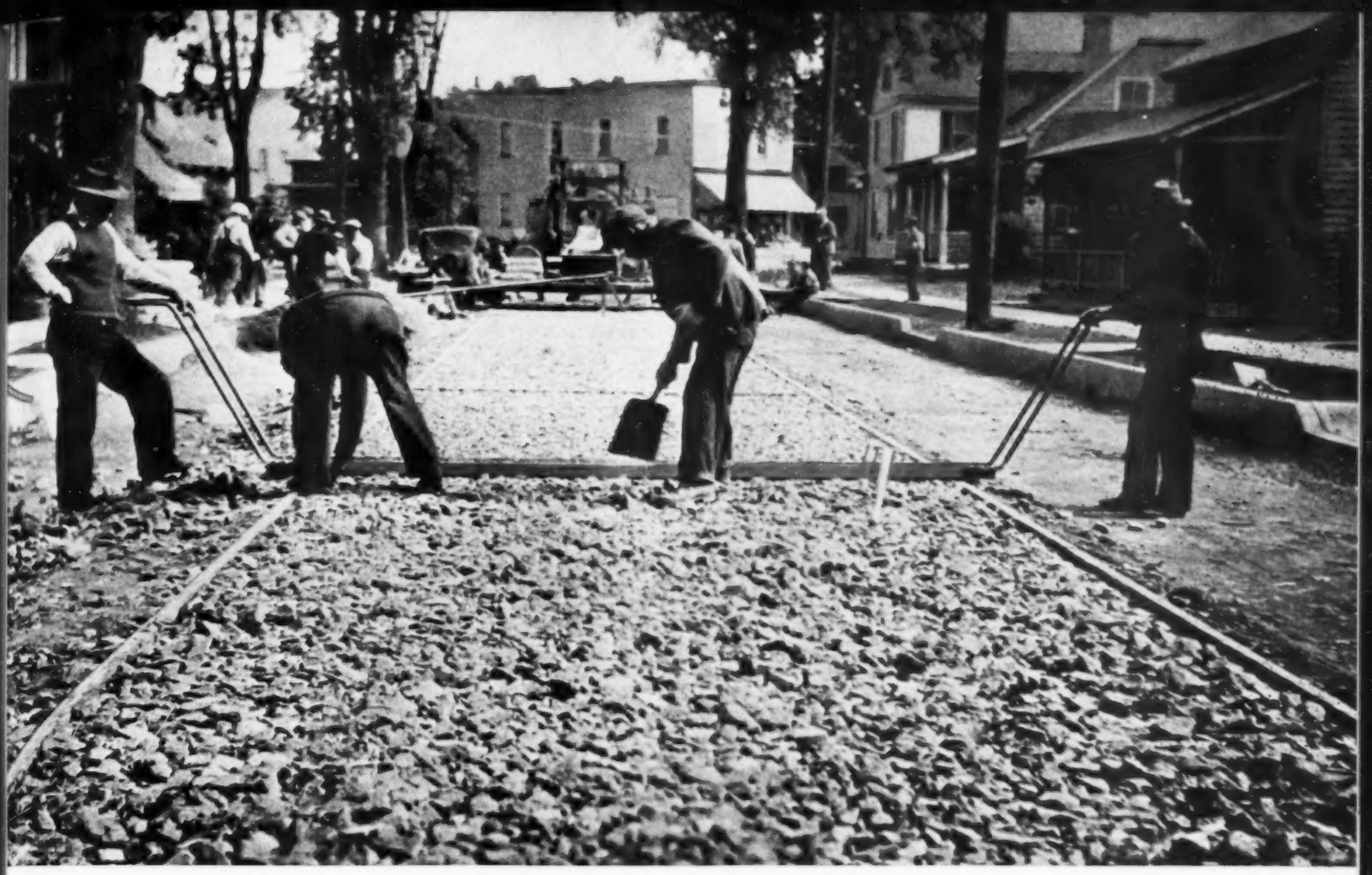
Odors at the screening chamber have been somewhat offensive, due to the release of sulphuretted hydrogen and other gases at this point; which gases presumably form during the flow through the 36-inch pipe,* combined with the infiltration of some salt water. To suppress the odors, the screening chamber has been covered with a concrete roof, and the gases are removed from above the sewage through a pipe, by means of an electrically driven blower which passes them through a pipe and and upward through a salamander in which a fire is kept constantly burning. There was little odor around the plant at the time of the writer's visit, and all complaints are said to have ceased.

One is impressed with the way the government has provided for sanitary protection of the city and its visitors. The engineers of the department extended every courtesy and opportunity for visiting the public works.

Bituminized Cement

The addition of about 4 per cent. of bitumen to Portland cement retards setting and hardening but does not detract from the final quality of the concrete. (See *Road Abs.*, 1935-36, No. 54.) The gradual hardening tends to eliminate internal stresses and to reduce cracking. Initially the production of a homogeneous mixture constituted a serious difficulty; the addition of quicklime impregnated with bitumen was not satisfactory, and an atomization process was ultimately adopted with success. Bituminized cement is almost indistinguishable in appearance, specific gravity, or particle size from Portland cement. The initial absorption of water is slightly less. The maximum temperature was found to occur at 28 hours, as against 22 hours in the case of Portland cement under similar standard conditions. The slightly lower tensile and compressive strengths at 28 days were found to have risen to the normal values in 6 to 8 weeks. Both expansion and shrinkage were much more gradual than in the case of Portland cement, and bituminized cement is hence much less sensitive than Portland cement to variation in the moisture content of its surroundings. Initial failures in the use of bituminized cement in the production of cement grouted macadam were traced to premature drying. The thin surface film formed by the application of a dilute bitumen emulsion is the most effective form of protection; surfacings cured in this manner for about 12 days have proved entirely satisfactory. Road Abstracts; F. KNAPP: *Schweizer. Zeit. Strassenwesen*, 1935, 21 (16), 265-8.

* The average flow would be at the rate of 5 ft. per minute, and this pipe must therefore act as a long septic tank.—Editor.



From the quarry to the curing of the pavement, relief labor did the work.

Cement-Bound Macadam with Relief Labor

By Neil Havens

Superintendent of Public Works

AS soon as possible under the Federal relief work program, the city of Glens Falls, N. Y., got under way a paving project which was designed to be a permanent improvement in the fullest sense.

The complete project consists of paving 2,700 feet of streets with 6-inch cement bound macadam 30 feet wide. In addition to the work required for actual construction, men were given work both in a city-owned quarry producing coarse aggregate, and in a sand pit producing the fine aggregate.

The quarry is equipped with a No. 2½ portable Climax crusher having 10x12-inch jaws set for a 4-inch opening to produce aggregate 1 to 3 inches in size.

In the sand pit, 6 to 8 inches of overburden had to be removed to reach the sand, which shows no loam and which has been used by the city for concrete with satisfactory results for several years.

Steel forms held with steel pins were used. Earth was piled against the forms to prevent leakage of grout and to resist thrust of the 9-ton roller used on the dry stone. After rolling, flat stones in the surface were broken up or removed.

The pavement was placed in three lanes, a 10-foot lane in the center and two 9-foot 4-inch lanes on the sides. One-half-inch expansion joints were used at 50-foot intervals. To protect these during rolling, hooded bulkheads of ⅛x6-inch plate, with a ¾-inch angle spot welded to the edge of the plate, were used and removed after the roller had completed compaction of the grouted surface.

A 1:2 grout was mixed in a 2-bag Jaeger mixer equipped with a 12-foot chute with 1-inch perforations on 3-inch centers in the last 4 feet of the chute. This was mounted on a platform with wheels which rode the steel side forms. Sand was measured in struck-off wheelbarrows. Six gallons of water were added to give an estimated content of 8½ gallons. Grout had a flow of 19 to 21 seconds. Cement content on the finished work was 0.8 bag per square yard.

A Job "Kink"

A "kink" which improved results was the use of ¾-inch mesh chicken wire 6x10 feet placed longitudinally on the surface of the stone under the distributing spout during grouting. This permitted working excess group forward with minimum disturbance of the surface stone and the contour of the pavement, and greatly facilitated the work.

Final compaction was with a 6-ton 3-wheel roller passed over twice immediately after grouting each 50-foot panel. Two tamping templates, one made from a 10-inch steel channel and one from a steel shod 8x8-inch timber, were used. Both were equipped with plow handles at each end and were used transversely and longitudinally to level high spots.

Surface finish was with a long-handled float, followed by a burlap drag. After the sheen had disap-

peared, the surface was broomed and edged. It was then covered with straw and wet down for curing.

A rough check indicates that the cost of the work, including labor, material, equipment and forms, amounted to approximately $1.10 per square yard.

Personnel consisted of: 1 foreman; 1 mixer operator; 2 sand shovelers; 2 sand wheelers; 4 stone placers; 2 form setters; 1 cement batcher; 1 roller; and 2 finishers. The author was in charge of the work. PUBLIC WORKS is indebted to Concrete Highways and Public Improvements for this article and for the accompanying illustrations.

To minimize disturbance of surface stone when grouting, a ¾-in. mesh chicken wire is placed under the distributing spout. It is left in place until surplus grout is broomed away.

Indiana's Roads in Relation to Her Future Development

By James D. Adams

Chairman, State Highway Commission of Indiana

Extracts from a paper presented at the Twenty-second Annual Purdue Road School January 20-24, 1936

IN 1935 in my address before this group, three policies were advocated. First: That work of shoulder and culvert widening should be continued. Second: That our department should inaugurate the construction of divided lane highways. Third: That in planning highway development we must recognize the imminence of extensive rural electrification.

On last December 24th, I had occasion to motor north from Indianapolis on U. S. Highway 31. The first ten miles out of the city has the wide shoulder with shallow side ditch. The pavement was covered with packed, slick snow. Motorists were skidding about, driving carefully. In spite of caution several cars had slipped from the pavement but with the wide, flat shoulder each was able to get back on the highway on its own power.

Upon leaving that portion of the highway where the shoulders had been widened and entering upon the portion which has but a 50-foot right of way with deep abrupt ditches close to the pavement, the scene quickly changed. In the first quarter of a mile, three cars had been in the ditch and each had had to be pulled out by a wrecker. Within a distance of twenty miles, five wrecks were still along the highway. One was a car off the road lying on its side. A little further on, a large ambulance was in the ditch with a bent front wheel. A patient was in the ambulance.

Still further a truck with the right rear wheel broken off as the result of a slight skid which landed in the deep, abrupt side ditch. In the remaining distance to the junction with Road 28 two more passenger cars were wrecked due to sliding off the slippery pavement. But this is only part of the story. No less than seventeen additional cars had skidded off the pavement and, owing to the narrow right of way and deep side ditch, had to be taken out with a wrecker.

By comparison, we had no wrecks on ten miles of widened shoulder as compared to twenty-two wrecks in twenty miles where the shoulder had not been widened. For the motorist who suffered car damages, he could have afforded to pay a considerable share of his property loss to have had a safer highway on which to drive during a condition such as existed that day.

Since this widening work was started in the fall of 1933, we have extended the shoulders on 887 miles of highways. We have widened several thousand culverts and bridges. This widening program has made possible the planting of trees and shrubs along our roadways. It will take five years or more to begin to see the effect of this work. Roadside plants will add to the beauty of our highways and will increase in attractiveness as the years pass.

During the past year, contracts were let for the construction of the first divided lane on the Indiana State Highway System. It consists of thirteen and a half miles on Road 30 across Lake County. A right of way, 200 feet wide, has been purchased. Each traveling surface will be 22 feet in width and a space of 44 feet will be left between the two lanes.

The divided lane highway was advocated because it would provide greater motoring safety. A glance at the daily newspaper confirms the deadliness of the head-on collision.

Rural electrification was advocated because it would tend to build a strong rural population. In order to bring social advantages and to build up a strong citizenry, the development of an adequate secondary road system goes hand in hand with the rural electrification in order to achieve this objective.

The State Highway Commission has supported the rural electrification movement. In my discussion last year it was pointed out that rural electrification would be carried out in Indiana within the coming few years and that these new pole lines should be so placed that they would not soon have to be moved at tremendous expense when it should become necessary to widen the roadways. During the past two and a half years utility companies have spent untold thousands of dollars in moving poles along widened rights of way. This same mistake should not be made with rural electric lines.

The Old Greenwich plant under winter conditions.

A Report on Grinding Garbage and Treating It with Sewage in Greenwich, Conn.

Guy E. Griffin*

GREENWICH sewage is treated in four primary treatment plants. The Cos Cob and East Port Chester plants consist of septic tanks operated alternately as sedimentation tanks and unheated sludge digestion tanks. The Grass Island plant has ten shallow Imhoff tanks with insufficient sludge digestion capacity. At Old Greenwich there are two rectangular, plain sedimentation tanks and a heated separate sludge digestion tank. The settled sewage from each plant is discharged into Long Island Sound. Primary treatment only for Greenwich is approved by the State Health Department and meets the requirements of the Tri-State Treaty of New York, New Jersey and Connecticut for abatement of pollution of New York Harbor and Long Island Sound. The plant effluents are chlorinated during the bathing season.

There is no excess capacity for sludge digestion at any of the plants except Old Greenwich and that is only for a normal increase in population served by the plant.

Quantity of Garbage and Sewage Solids

From the experimental work of Keefer and Kratz (2), Fair (3), Whitley (4), and others it appears that for successful digestion of garbage solids with sewage solids the volatile solids in the garbage should not exceed that in the sewage solids.

Metcalf and Eddy (5) have estimated that the average amount of garbage to be expected in Greenwich is one and one-quarter pounds per capita per day and that the estimated present population contributing garbage is 33,000. The product of these figures gives an estimated daily garbage production of 41,250 pounds or approximately twenty tons. Keefer (6) and Fair (3) give figures showing that garbage may be expected to contain 25% solids and 75% moisture. Of the solids 90% is volatile matter. Applying these figures give:

Aver. dry garbage solids per day.... 10,000 lbs.
Aver. dry volatile matter per day... 9,000 lbs.

These figures would probably be increased 50% during the summer.

From the records of sewage flow and analyses of weekly samples composited every two hours during each eight hour working day at each of the sewage treatment plants during 1935, the computed quantities of suspended solids removed from the sewage at each of the plants is as follows:

Raw Suspended Solids Removed From Greenwich Sewage in 1935; Pounds Per Day (Dry Solids Basis)

	Total	*Volatile Matter (70%)*
Grass Island	2600	1820
Old Greenwich	403	282
Cos Cob	380	266
East Port Chester	850	595
Total	4233	2963
Greenwich Garbage	10,000	9000
Ratio of Garbage solids to sewage solids.	2.4	3.0
Ratio of Garbage solids to Grass Island sewage solids	3.8	4.9

From this tabulation it is seen that the volatile matter in the estimated quantity of garbage is three times the amount of volatile matter removed from the sewage at all the sewage treatment plants and is nearly five times the amount removed from the sewage at Grass Island.

A criticism of these figures may be that perhaps all the garbage would not be removed with the sewage. In that case, which is quite probable, the difference would pass out with the effluent and increase the demand for

*Sanitary Engineer for the Sewer Commission of Greenwich, Conn. This article comprises the technical portion of a report to the Sewer Commission, requested as a reply to the public demand of a local attorney, that the town officials investigate the possibility of disposing of garbage by grinding before proceeding further with an incinerator project for burning both garbage and rubbish as recommended by Metcalf & Eddy, Consulting Engineers.

oxygen in the harbor waters or require costly expenditure for construction and operation of secondary units for complete treatment.

Other Considerations

The problem appears to be not merely one of grinding the garbage and conveying it through the sewers to the sewage treatment plants but primarily the greatest part of the problem is the satisfactory treatment of the garbage in the sewage treatment plants.

At no sewage treatment plant of which the author knows, where ground garbage has recently been treated, has all the garbage of the community been so treated for an entire year. The Indianapolis experiment was for seven months during the summer. In each of the experiments the quantity of garbage solids has been considerably less than the sewage solids. The experimental work of Keefer and others indicate that garbage solids in excess of sewage solids do not digest. The experiment apparently has not been tried for any length of time in any primary treatment plants such as exist in Greenwich.

Since the estimated quantity of volatile garbage solids for Greenwich is several times the volatile sewage solids removed at all the plants, the scheme appears to be impossible on the basis of present knowledge, even if all the plants were utilized. It follows that utilizing one plant such as Grass Island, as has been suggested, is out of the question.

Even if such a plan appeared possible, the Town Counsel has given an opinion that a grinding station could not be located at Grass Island due to a restriction in the deed of the property. If such a station were located on the sewers serious difficulties might be encountered due to depositing of solids in the relatively small sewers along the shore which have a low velocity, particularly at times of high tide. Keefer (6) points out that central grinding stations are noisy and can be heard for several hundred feet, and that they are not free from odors even under the best operating conditions. This calls for isolation which is not easy to find along Greenwich sewers.

Considerable publicity was given this problem in the local newspapers. Most of it centered on the question of grinding garbage, with only slight attention given to the problem of treating the garbage solids at the sewage treatment plants. That is the main problem. There is probably little question that garbage can be successfully ground. Some publicity was also given to a small home grinding unit now on the market. It was perhaps inferred that each household might purchase one of these. The cost, installed, is approximately $160. If the estimated population of 33,000 be divided by 5 for an average family, it gives 6,600 households to which the total cost of such installation would be over a million dollars. This suggestion is not practicable, not only from a financial standpoint but from the fact that garbage is now collected from considerable areas not served by town sewers.

Cost Data

Some cost figures were presented in the newspapers comparing only the cost of grinding garbage against Metcalf and Eddy's (5) estimated cost for incineration of both garbage and rubbish. This was a rather misleading comparison of the partial cost of a process for a partial solution of a problem, against the cost of complete solution. Keefer (6) states, "If it is assumed that garbage will digest and can then be dried as readily as sewage solids, the cost of treating garbage containing 25% solids would average $2.81 per wet ton. When the grinding charges are included, the total cost per ton under average conditions would be about $3.20. These amounts do not include any further expense that might result from the production of additional screenings, grit, scum or grease. Moreover, the cost of possibly having to provide somewhat larger secondary treatment units has not been included."

Metcalf and Eddy's estimated cost of incineration of garbage and rubbish is $1.71 per ton. The fairer cost comparison then is not 30 cents for grinding garbage but $3.20 per ton for grinding and treating garbage in a sewage treatment plant against $1.71 for incineration.

Too few necessary data are available to even attempt a cost estimate of additional structures which would certainly be necessary at all the sewage treatment plants of Greenwich if this plan had any promise of success.

Both the State Health Department and the State Water Commission of Connecticut have been consulted on this problem and neither at present approve of the scheme of using the Greenwich sewage treatment plants for treating garbage.

Even if it were possible to treat the garbage of Greenwich at the sewage treatment plants, this would be only a partial solution of the entire problem.

The city officials of Schenectady, N. Y. (7), after considering the possibility of grinding garbage and treating it with the sewage, decided to have an incinerator. The seriousness of the rubbish dump situation made the construction of a garbage and rubbish incinerator popular.

Metcalf and Eddy's report of June 5, 1935, stated, "For the disposal of garbage there are available a number of methods, some of which have been used for many years and others of which are still in the experimental stage."

"Of all the available methods of garbage disposal, there is no question but that incineration is the method which should be adopted by the town of Greenwich."

Perhaps the most notable advancement in experimental processes noted in the technical literature since the date of this report is the plant scale experiment of grinding garbage and discharging it to the sewage treatment plant in Indianapolis (8) (9). The Indianapolis plant, however, is many times larger and differs greatly from any of the Greenwich plants.

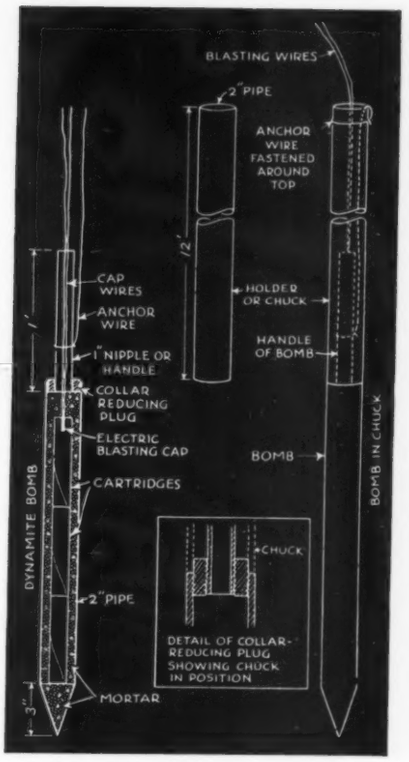
Summary and Conclusions

1. The process of grinding garbage and flushing it to sewers for treatment at a sewage treatment plant has been tried at only a few cities in this country.
2. There is conflicting evidence as to the success of the procedure.
3. Most of the plants where it has been tried are complete-treatment plants.
4. Greenwich plants are approved primary treatment plants.
5. So far as could be learned the procedure has not been used for all the garbage of a community for a full year at any sewage treatment plant, and has not been used at any primary treatment plant for any appreciable time.
6. At each plant where recently tried the volatile garbage solids have been considerably less than the volatile sewage solids.
7. The estimated amount of volatile matter in Greenwich garbage is three times that in the solids removed from the sewage at all the Greenwich plants and five times that in the solids removed from the sewage at the Grass Island plant.
8. Experimental data to date indicate that volatile garbage solids in excess of volatile sewage solids will not digest at all, or only with difficulty.
9. It follows that on the basis of present knowledge the plan is not advisable even if all the plants were utilized and apparently not possible for any one of the plants to treat all of the garbage of Greenwich.
10. Even if it were possible, the estimated unit cost is in excess of Metcalf and Eddy's estimated unit cost for incineration.
11. This scheme would not completely solve the refuse disposal problem of Greenwich.
12. Not enough advancement has been made in any other method of garbage disposal seriously to affect the recommenda-

(Continued on page 15)

Dredging With Dynamite

By F. R. Cozzens



The methods of preparing and wiring the bombs, described in the accompanying article, are shown at the right.

UNDER-WATER excavating with modern equipment is no longer considered a serious problem, but for every major project thus managed, there are a dozen smaller jobs in shallow streams where dredges and power shovels cannot be used. A typical case was the building of the Short Route Highway through a section of Athens County, Ohio, where it was necessary at three points to deepen the channel of Wolf Creek for a total distance of one and three-tenth miles. This stream is winding and rocky. The average width is fifty feet, with irregular fluctuations in depth of from three to eight feet. The channel bed is of shale and sandstone composition, too rocky for efficient dredging and too irregular for ordinary ditching.

Specifications called for a uniform channel eight feet in depth. After three different contractors had abandoned the project, the Johnson Company, of Trimble, Ohio, accomplished the task in record time by the use of dynamite bombs. The actual excavating was done in 140 working hours, using 1,700 pounds of nitroglycerin dynamite, 600 electric blasting caps, 6,000 feet of copper wire and 1,500 feet of two-inch iron pipe.

The bombs were made in advance, using thirty-inch sections of the pipe, the bottom ends of which were welded to a point after cutting out four gores. Next, concrete mortar was poured in to a depth of about three inches and permitted to harden. Then, in each shell was loaded, end to end, the required number of cartridges, and the last one inserted carried an electric blasting cap with insulated copper connecting wires. To seal the charge, more concrete was poured in, and then a one-inch reducing bushing was screwed into the collar of the pipe. Above that, similarly attached, was the nipple or "handle" extending about one foot, and through the hole along the axis of this piece, the cap wires referred to were threaded, thus completing the assembly. These details are more clearly shown in the illustration.

When the blasters were ready to start work, a bomb was placed in a chuck or holder—a section of two-inch pipe ten to twelve feet long—through which the leading wires were drawn up and left free. Next, the bomb was secured in the holder by means of a wire between the bomb handle and the top of the chuck. These preliminaries completed, the outfit was pushed down into the bed of the stream. The holding wire was cut and the chuck used to drive the bomb to the required depth.

The chuck was then carefully withdrawn, leaving the bomb planted in the bed. One of the workmen next attached the free end of the cap wires to a piece of wood floating at the surface, and the planting process was resumed and continued until ten or more bombs were set. This work completed, the cap wires were connected in series, then taped securely and joined to the leading wires of the blasting machine on the shore. All the charges were shot together.

The bombs were spaced eight to twelve feet apart, usually in the center of the channel, and side shots were used only where jutting rock ledges made them necessary. The channel shots loosened the stone and silt so thoroughly that much of the material was quickly carried away by the swift current. Large blocks of broken rock were maneuvered to the shore by man power, and the remaining burden was removed by scrapers.

The use of bombs eliminated the drilling of holes, at a substantial saving in labor and time. A crew of three men, operating in shifts on the boat, did all the necessary planting, while a fourth man handled the blasting machine. A barge and scraper crew completed the job.

Bombs of the type described are effective in solving the problems of excavating channels in shallow fast-water streams. They may be loaded to any strength desired, are easily constructed and conveyed to the job, and can be used successfully in locations where it is not possible to employ other methods.

Report on Grinding Garbage

(Continued from page 14)

tion of Metcalf and Eddy that incineration is the best solution of the problem of Greenwich.

13. Neither the State Health Department, nor the State Water Commission of Connecticut approve of treating garbage in the sewage treatment plants of Greenwich at the present time.

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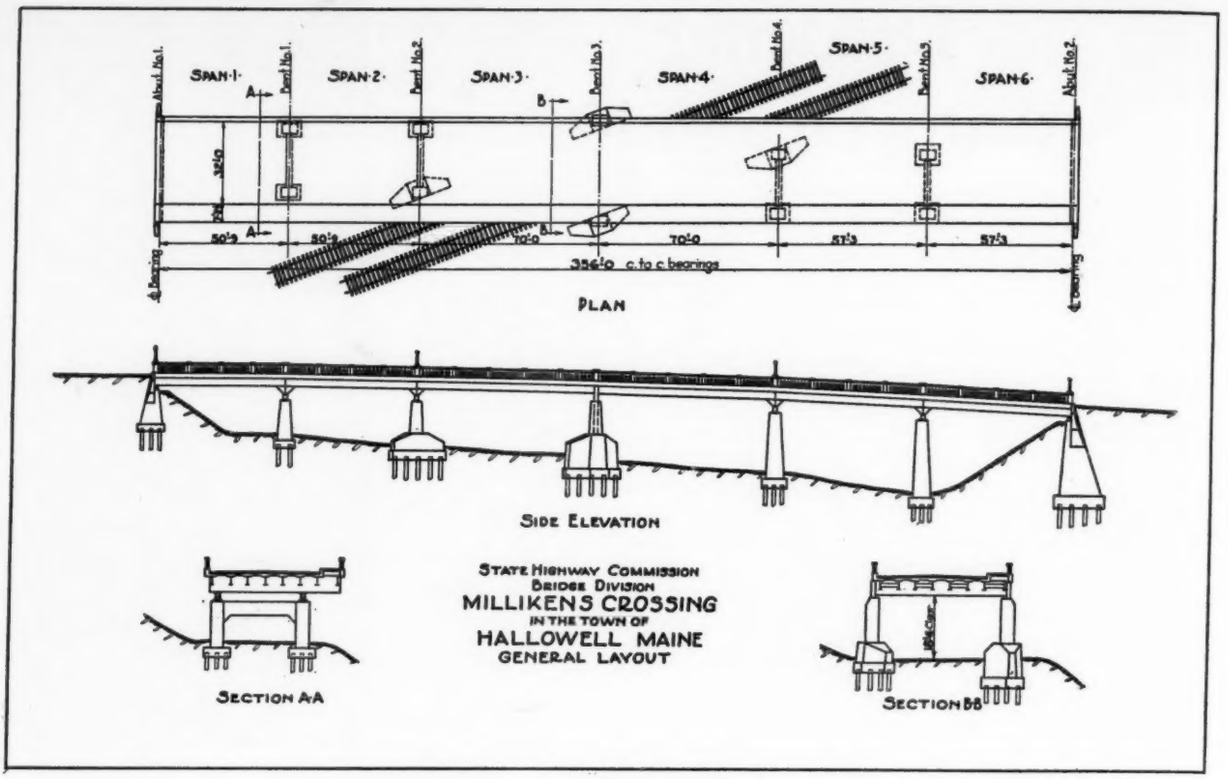


Fig. 2. General plan of the Milliken's Crossing grade elimination.

Eliminating a Grade Crossing in Maine

By E. A. Mac Lean,

Senior Engineer, Bridge Division, Maine State Highway Commission

ONE of the most dangerous grade crossings in the State of Maine was eliminated this past summer by an overpass constructed under the United States Government's National Recovery Program. The crossing is located in the City of Hallowell and is over the tracks of the Maine Central Railroad. The highway is one of the main arteries through the State and it also carries a great deal of local traffic. The old highway was narrow. It wound down over a hill on a blind "S" turn to cross the railroad at a sharp angle. All these conditions combined to make a very hazardous crossing, especially when the roads were icy.

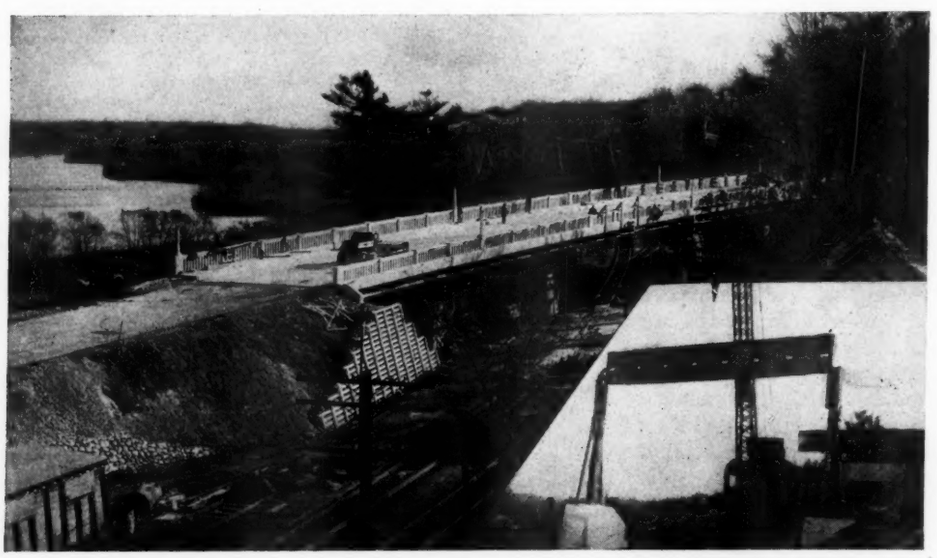


Fig. 4. Showing the project in the final stages of construction. The inset is Fig. 3. This shows the placing of the bents, with the center bent straddling the railroad. Bent 2 is shown in the right background.

The terrain at the crossing is very hilly, as may be seen from the aeroplane view, Figure 1. The railroad is about 40′ above the river, the highway at the lower left hand corner of the picture is about 70′ over the railroad and the houses on the left at this same point are on ledge that is 30′ higher. From that point on, the ground continues to rise more gradually to the left. In the upper part beyond the crossing, this same picture shows that the highway lies between the railroad and the river. A short distance from the crossing on both sides the railroad runs parallel to

the highway. These limiting physical conditions made a satisfactory solution to the problem difficult. The line used follows the old highway quite closely, but three houses were destroyed, four more were acquired by the State and a number of others were seriously damaged.

Elements in Design

The grades on the highway were limited to 6% and the curves to 6°. The grade across the bridge proper is 1%. The roadway is 32′-0″ and it has a 6′-0″ sidewalk on one side. The clearance over the railroad tracks is 18′-6″. The bridge, which is designed to carry an H-20 loading, consists of six continuous steel girder spans. A general plan of the structure is shown in Figure 2.

The railroad crosses the highway at an angle of about 22°. For this reason the center bent had to straddle the railroad (see Figure 3) and the floor beams at the adjoining bents overhang the railroad in order that the column and collision wall might not be closer than 9′-0″ to the center line of the railroad tracks. There are two spans of each of the lengths 70′-0″, 57′-3″ and 50′-9″. There are eight rows of continuous girders made of rolled I-beams. They are spliced at the bents. The girders are supported at the bents by steel floor beams. The top flange splice plates for the girders are carried across the top of the floor beams and the bottom flange splice plates thread through slots in the floor beam. These openings may be plainly seen in Figure 3. Bent 3 is being erected in this picture. In the background may be seen Bent 2 with the bottom splice plates already erected. A large saving in structural steel was effected by making the spans continuous. The Cross method of distributing fixed end moments was used in the design of the girders as continuous beams. By systematizing the work so that the effects of the various combinations of live load could be added together to give the same result as for the structure continuously loaded, a great deal of intermediate checking was eliminated.

Design of Beams

The deflection of the beams under dead load was computed and to this was added the "hump" due to the vertical curve and this total camber was rolled into the beams. As the dead load was placed on the structure a careful check was kept upon the behavior of the beams in the various spans. It was found that the actual deflections were very close to the predicted deflections.

Reinforced concrete skeleton piers and abutments were used for the substructure. Where the bridge is fixed at the center pier the steel columns are encased in concrete. The foundation for the bridge proved to be very deceiving. Where natural ground was encountered a layer of rocks and gravel was found to overlay a strata of soft clay several feet in thickness. This condition was unexpected. On one side of the railroad there is filled ground and it contained a large number of large rocks, perhaps the debris from an old stone masonry retaining wall. Steel H-beams were used in all foundations as piles to penetrate through to refusal. Some of the piles in the foundation are 80′ long.

At the ends of the abutments toward the railroad, concrete cribbing was used to keep the fill from spilling out onto the railroad. By doing this the length of the bridge was shortened many feet.

Construction Methods

The concrete was placed in the floor in the following order of spans 2, 5—1, 6—3, 4. This was done in order that the deflections would be kept as small as possible and the camber properly determined. As spans 2 and 5 were poured the I-beams deflected and the concrete set up with the beams in this condition. It is obvious that when spans 1 and 6 were poured an uplift was caused in spans 2 and 5, relieving some of the compression in the top flange at the center of the span thus putting the concrete immediately in tension. At the support the tension in the top flange was increased putting tension in the concrete. When spans 3 and 4 were poured this tendency was increased a great deal as they are the long 70′ spans. At this time a few cracks appeared in the curbs of spans 2 and 5. In the construction of a structure of this type the curbs should be heavily reinforced to keep the cracks as fine as possible and when pouring the concrete in the floor the spans should be broken up into thirds with construction joints between. The third sections should be poured, one in each span, in the same order that the full spans would be poured.

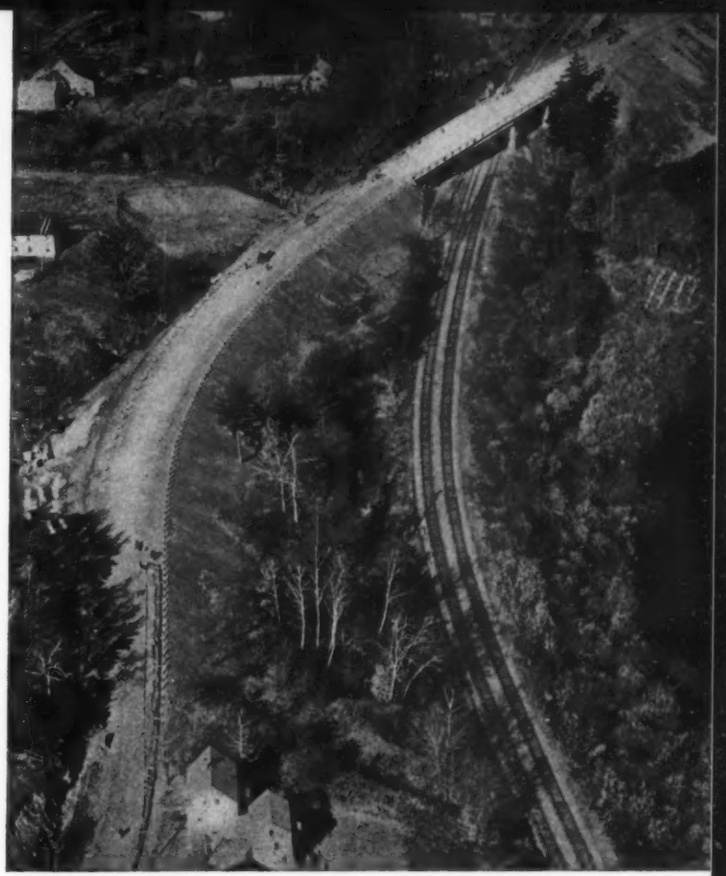


Fig. 1. View from the air of the railroad, highway, new bridge and the river. The houses on the left, mentioned in the text, do not show; they stand on the high bank in the extreme lower left corner.

The structure in the final stages of construction is shown in Figure 4. The road will be paved after the fill has settled for a season.

There are 604,000 pounds of structural steel, 6,600 feet of steel H-beam piling, 2,000 cubic yard of concrete, 47,000 cubic yards of earth fill in the project. The cost of the project was $126,000.00 exclusive of engineering and land damage.

The American Bridge Company fabricated and erected the structural steel. The contractor for the balance of the structure was Hector J. Cyr Company, Inc. The author was in immediate charge of the design and plans. The resident engineer was H. E. Towne. All the engineering work was done by the Bridge Division of the Maine Highway Commission under the supervision of Max L. Wilder, bridge engineer.

An Improved Plasticity Needle for Soil Study

By C. A. Hogentogler, Jr.

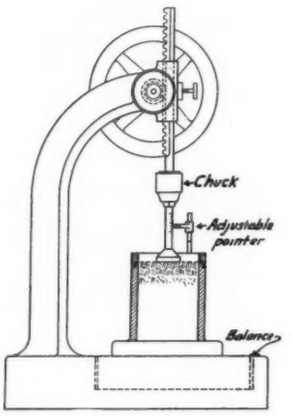
AN IMPROVED plasticity needle has been designed for laboratory use at George Washington University in connection with a research project on soil stabilization under the Department of Civil Engineering, supervised by Prof. F. A. Hitchcock.

In the use of the plasticity needle, as originally designed, the possibility of personal error was very high for the following reasons: (1) It was almost impossible to obtain perfectly vertical movement during penetration; (2) The position in which the operator was forced to stand made accurate measurement of the depth of penetration very difficult, especially when the soil, adjacent to the area penetrated, bulged; (3) A constant rate of penetration was very difficult to attain, partly because of (2), but more because the movement of the handle, due to deflection of the force indicating spring, could be several times the movement of the needle footing. In addition, the resistance to penetration, even at the optimum moisture content, is often found to be greater than the maximum of 2,000 lbs. per sq. in. which can be measured with the original needle.

The new instrument has the design features shown in fig. 1. It is essentially a form of press which insures vertical movement of the footing, accurate measurement of the depth and, hence, control of the rate of penetration. The pressures are determined by means of a platform balance of 300-lb. capacity and not subject to appreciable vertical movement. Depth of penetration is measured by means of a pointer referring to graduations on the needle stem. With the same needle footings used in the original plasticity needle, pressures up to 6,000 lbs. per sq. in. can be measured.

Test Procedure

The procedure for this test has been as follows: The cylinder with the compacted soil is placed on the balance and the needle footing adjusted to just touch the soil. This may be done accurately by noting the elevation where the slightest pressure on the lever arm will cause an increase in the balance reading. The pointer is set at zero. The weight of the cylinder and compacted soil is recorded as the initial reading. The needle is then slowly forced into the soil at the rate of ¼ inch per minute and balance readings are taken at each succeeding quarter inch depth of penetration. The force of penetration may then be computed from the area of the needle footing and the balance readings (less the initial reading).



The improved plasticity needle.

The curve, fig. 2, shows a very interesting relationship between pressure and depth of penetration for a sandy soil and illustrates graphically the necessity of measuring accurately the depth of penetration. The tendency of the soil to "build up" resistance as the depth of penetration is increased may be clearly seen.

There are two requisites for stability of graded soil roads under both wet and dry conditions: (1) There must be enough capillary bond in the granular material to provide stability when the binder clay becomes very wet; (2) There must be enough clay to retain the minute cohesive films after the larger films of capillary moisture have evaporated in order that stability may be maintained during dry weather. Much attention has been paid to providing the last requisite in road surfaces and in base course construction; however, the first requisite, that of stability under extreme conditions of moisture is the more important consideration if failure of the entire road structure is to be prevented.

The apparatus, as described, is being used in the development of a test to disclose the best gradings of soil mixtures for providing stability under the wet conditions likely to be met with in soil roads and especially in base courses. The procedure used is as follows: To the graded granular material available for use on a given job is added varying percentages of the clay binder available also on the same job. The mixtures are then placed in molds such as the Proctor compaction cylinder at moisture contents high enough so that they will completely slump to maximum density. After this the samples are allowed to drain over night so that the next morning when the tests are made the samples will contain only the capillary moisture. Penetration tests are then made by means of the new device.

The resistance to penetration plotted against the percentages of clay very clearly discloses the clay content at which maximum stability is obtained. Figure 3 shows the relationship thus obtained. In this case, it will be noted that maximum stability is furnished by an admixture of binder clay equal to 2.5 per cent. Increase or decrease of clay content from this amount causes considerable decrease in stability. From work done thus far it seems evident that the character of the curve, in so far as the optimum binder content is concerned, is not dependent on the depth of penetration.

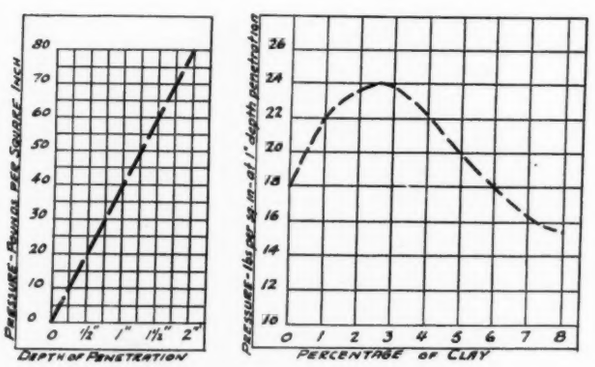


Fig. 2. Pressure and penetration depth relationship; right, Fig. 3, maximum stability test.

The Editor's Page

Flood Control Aspects:

The severe and widespread floods of the past few weeks have again focused attention on the matter of flood control, just as a decade or so ago, the Mississippi River floods brought to the forefront the problem of handling the Father of Waters. Bills have recently been introduced into congress for a comprehensive program of flood control extending over the coming ten years.

Just at present, the advocates of flood control by reservoirs seem to have the upper hand, partly because this method of flood control dovetails to a considerable extent into the work of soil conservation and erosion prevention. The present tendency also seems to be toward the construction of large reservoirs, rather than small ones.

There are, of course, difficulties in the way of flood control on our larger rivers by means of reservoirs. Reservoirs as large as Boulder Lake cannot be built on every river; reservoirs of that size can really accomplish flood control, but the average large dam can not retain flood waters for any considerable length of time. Such a dam can reduce the crest of the flood, but not much more.

It should be noted that floods, such as the one at Pittsburgh recently, are caused either by the coincidence of high waters in two or more tributaries, or by severe local rains which contribute an added volume of water to a stream already running bankfull. As we recall, the most disastrous phases of the Mississippi floods of 1927 were due primarily to the latter cause. In fact, the Ohio did not ever contribute materially to the damage done by that flood, producing only some 900,000 second feet, while its maximum is around 1,400,000 second feet.

A whole lot of study is necessary before flood control by reservoirs located on headwaters and tributaries will be effective with our larger rivers. Even then there will be difficulties. Flood waters cannot be held indefinitely —even with an empty reservoir, two or three weeks detention will probably be the maximum; in most cases it will be much less. The problem then is to release this flood water so that it will reach some point down river, perhaps 500 miles away, at a time when local rains have *not* contributed materially to the flood flows; and when other tributaries have *not* arrived bearing a superfluous amount of water. Of course, this cannot be done.

But this does not mean that flood control is not possible or needed. We believe very strongly that a reasonable degree of control is possible. It can not be hoped that every riverbank dweller can be kept high and dry with flood control, but a great deal of damage can be prevented, and many lives saved. We are for a comprehensive program by the Federal Government, based on scientific knowledge and scientific methods. Such a program will undoubtedly save its cost many times over in the next twenty years; and right now it will provide a lot of employment on essentially sound and worthwhile projects.

Another type of flood control is based on the levee or dyke system. This also is valuable, as witness one of the Ohio River cities which last month sat securely behind its million-dollar wall while neighboring communities suffered. Levees have afforded protection—not complete, but nearly so—to the Mississippi River valley dwellers.

Probably the completest degree of flood protection can be attained by a judicious combination of the two methods outlined. We believe that the reservoir type of control is wholly or largely a job for the Federal Government, while the local levee or dyke control is a job for the local government, aided and encouraged by the federal government.

The construction industry and the engineering societies should support the present movement toward a carefully planned flood control program, combining the most desirable features of both methods.

A New Light on Diversion of Highway Funds:

According to a study recently completed by the American Petroleum Industries Committee, deaths from highway accidents increase as highway monies are diverted to other sources. Whether the death rate was compared on the basis of gasoline consumed or on the basis of number of cars registered, results were about the same.

While it may be startling to have these facts brought out by a scientific study, a moment's reflection will show that it is only what we might expect. Narrow and high-crowned roads, narrow bridges, slippery surfaces, bad curves, blind curves and intersections, and inadequate maintenance are very important factors in accidents; overcrowded highways, due to the lack of parallel roads, may be added to the above-mentioned causes.

Engineers know what needs to be done to provide safe and adequate highways. We believe that there is ample money available from present sources for adequate highway construction and maintenance, to remedy in due time the defects causing fatal accidents. But if it is used for relief, for paying interest on debts, and for a dozen other politically desirable projects, which have no real bearing on the safety of life, we can expect our highway death rate to remain at its very high present level; it may even increase.

Our Cover Illustration:

On the front cover this month is the Oregon State Highway Commission's sketch of the partial cloverleaf grade separation at the entrance of the Bonneville Project on the Columbia River. It was sent us by R. H. Baldock, state highway engineer, who says: "An idea of the rugged and majestic scenery on the world-famous Columbia River can be obtained from this sketch, for the artist has drawn the panoramic surroundings in minute and accurate detail."

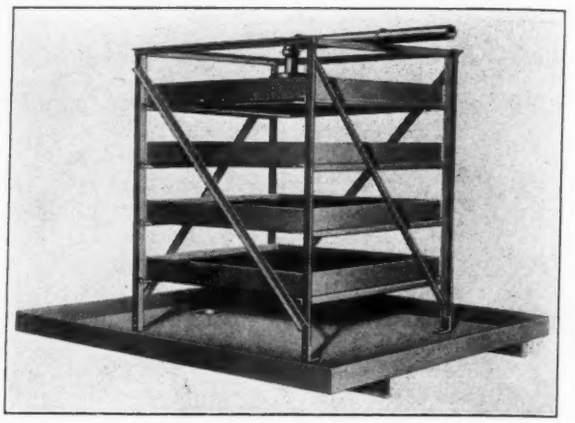
We believe that other engineers will appreciate this, and we thank Mr. Baldock for the opportunity of showing it. We are always glad to get interesting views of this sort, and invite our readers to contribute them. An article on roadside improvement in Oregon, contributed by Mr. Baldock, will appear in an early issue.

Equipment Used in Water Purification

Filtration

Aeration

SEVERAL forms of spraying aerators are furnished by the International Filter Co. in the shape of a distributing pan over three superimposed coke trays, with capacities varying from 45 to 1,000 gpm and tray sizes from 3 x 3 ft. to 7 x 14 ft.; head about 8 ft. Also a cascade aerator, consisting of 3 concentric circular trays, each 21 in. wider than the one above, over which the water falls in thin sheets, using a total head of 30 in.; also a "multicone" aerator, consisting of three concentric superimposed bowls, the water flowing from the top one to the next through several flat tubes which suck in air, and through a mixing throat, and then being sprayed upward into the second bowl, where the process is repeated; total head required, 4 ft.



Coke tray aerator

Filtration

In a few cases, coagulated water is clarified of its suspended matter by passing through sedimentation tanks only, but in the great majority of cases it is also passed through filters (generally rapid sand). For water which has not been coagulated, slow sand filters are used. Roughing filters for preliminary clarification generally receive uncoagulated water.

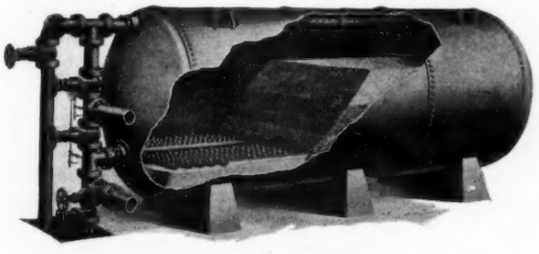
Slow sand filters are seldom constructed now in America, and comparatively little equipment is used in either constructing or operating them. In 1934 a 500,000 gpd slow sand filter was built by Newburyport, Mass. (partly because difficulty in coagulating the water was anticipated, partly because a larger percentage of the cost would go for labor), which used more equipment than most such filters. This included split tile underdrains, sand ejectors (provided for), Simplex rate-of-flow controllers, loss-of-head gauges, gauges showing height of water in each of the filters and clear-water basin, and a low-lift pump (Manistee centrifugal, driven by Ames Unaflow engine) with feed water heater.

The usual influent controlling device consists of a float on the surface of the water in the filter, which is directly connected to a butterfly or balanced valve in the supply pipe. The effluent rate of discharge is controlled by appliances similar to those which will be described for rapid filters. The sand is cleaned either by removing it from the bed with spades or similar tools, or by cleaning it in place with a Nichols or Blaisdell washing machine. The sand scraped off is removed by wheelbarrows or by means of a sand ejector and is washed and returned. In the Nichols machine the sand which is scraped off is shoveled into a portable ejector which carries it under pressure a few feet to a closed steel cylinder with a conical bottom, sand entering this at the top and passing out at the bottom, while water is forced in at the bottom and leaves at the top, washing the sand on the way and carrying the dirt to a drain. The washed sand is at once spread on the bed again. The Blaisdell machine consists of an inverted box 4 ft. square which rests on the sand, while water is discharged from a vertical hollow axle through hollow horizontal arms which revolve inside the box but several inches below the surface of the sand. The discharged water washes the sand and is removed from the box by a pump. The box is meantime moved slowly over the filter until all the surface sand has been cleaned.

Multicone aerator

Rapid sand filters were at first made round, of wood. The practicable size of these is limited and a fair-sized municipal plant requires a large number; and most such filters now are built of concrete in rectangular form, although many industrial and a few small municipal ones are still made round. If the filter is in constant use and therefore wet, and sheltered from the sun, wooden ones may last 25 years or more. Such a filter, as supplied by the International Filter Co., contains a collecting manifold of iron pipe, with brass strainers or merely perforations on the under side; wash-water troughs; also an air manifold for washing, rate-of-flow controllers, and loss-of-head gauges, if desired. These are made from 4 ft. to 18 ft. diameter; rate 1,510 to 30,600 gph for potable water, or 50% more for industrial use. Filters up to 18,000 gph are furnished for operation under pressure up to 67 pounds (more on special order). These are enclosed in steel tanks, but otherwise the construction is practically the same as the gravity filters, a series of rectangular concrete boxes placed side by side, generally in two rows with a pipe gallery between them,

an operating floor forming the roof of the gallery. Each filter unit consists of 20″ to 30″ of filter sand supported on 18″ to 24″ of graded gravel, in the bottom of which is a drainage system for removing the filter water,



which also is used for admitting wash water. The wash water is removed by wash troughs set approximately two feet above the sand. The filtered water flows into a clear-water basin, which is generally placed adjacent to the filters, in some cases under them.

The wash-water troughs are generally made of concrete, cast iron, rust-resisting steel, or (quite recently) "transite." They should have edges machined to furnish a true and level weir and it is well to have a lip on the outside of the edge to prevent sand being carried out. If made of steel, they should be reinforced at the edges with outside angles, and braced crosswise or with angles bent to fit around the outer surface. The edges must be set perfectly level, but the bottoms usually slope toward the discharge end.

The underdrains are most often made of a pipe grid of cast iron, transite, or other material, usually comprising a rectangular header to which are connected, at right

Permutit Company Strainers. At left, cast iron "umbrella"; center, brass strainer; right, stainless steel.

angles to it, smaller horizontal pipes spaced about 6″ apart. In these pipes are orifices drilled in the under side on about 6″ centers, or bronze or brass strainers are threaded into the tops of the pipes. Different designs of strainers are furnished by dealers in filter equipment. The International "umbrella" nozzle spreads the wash water downward around the nozzle, and, if air is used in washing, is arranged to discharged the air through the same nozzle. A number of filters have been built in which the sand rests directly on a metal screen or plate pierced with 1/16 to ⅛-in. holes through which the water entered. These gave trouble by clogging and corroding and are no longer being built.

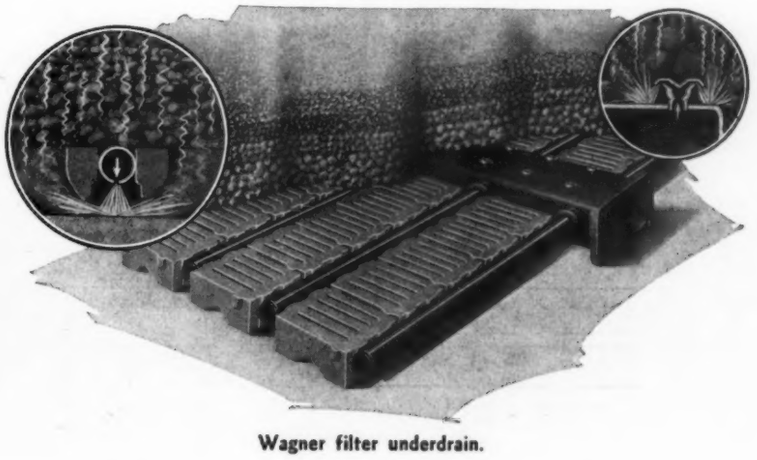
There are several special forms of filter bottom. The Wagner underdrain consists of a manifold and laterals with orifices on their under sides as described above but spaced 8″ to 12″ apart, and the spaces between the laterals completely filled with concrete blocks provided with slots and concave under sides. The water discharged from the laterals spreads under these blocks and rises through the slots in them, which slots are spaced about 2″ apart over the entire floor. The gravel rests directly on the blocks. The Wheeler system consists of a bottom formed of inverted truncated pyramids 12″ apart centers, filled with 3″ concrete spheres, over which are placed a layer of glazed earthenware marbles about 1¼″ diameter and over these the graded gravel. Recently the Carborundum Company is offering porous diffuser plates as a filter bottom, on which the sand rests directly.

Wash water may be obtained from the water distribution system under its pressure, or pumped directly from the clear water reservoir; but the preferred plan is to have a wash-water tank elevated at the height which gives the desired uniform pressure, and kept filled with filtered water by pumping or city pressure. If wash water is pumped direct, the pumps should be provided with rate control valves.

Each filter unit is generally provided with five valves an influent valve for admitting the water to be filtered, one in the effluent line, a wash-water valve on the line which brings the wash water to the filter, a valve on the drain which removes the wash water, and a waste valve, by which water which has passed through the filter can be wasted if desired. (The last is not generally used in routine operation.) All these pipes and valves are generally placed in the pipe gallery, but the valves, if hand operated, are provided with extension stems and floor brackets so that they can be operated from the floor above the gallery. In large plants, and an increasing number of small ones, the valves are operated hydraulically or electrically, by simply turning a handle or pushing a button. The controls for each filter unit are generally placed conveniently grouped on a stand opposite that unit; but in a few large plants all valves are distantly controlled from a single switch board.

In addition to these controls, a number of plants have arrangements for sampling the raw water, the final effluent, and at one or more intermediate points without the operator's having to dip up the samples by hand.

"International" umbrella nozzle.



Wagner filter underdrain.

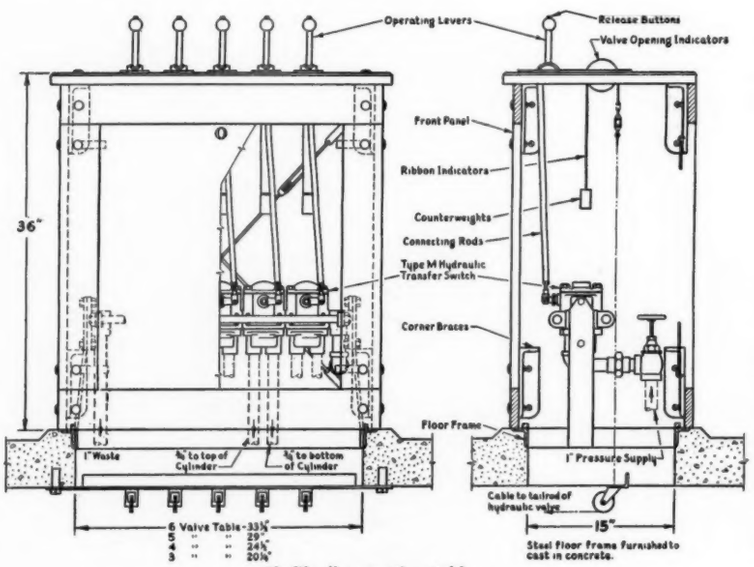
(For effective operation, samples should be taken for each filter or other operating unit.) By means of pumps, aspirators or other contrivances the water is raised to a point above the operating floor, where it can be drawn from a faucet at will; also it is a good idea to have it flow continuously through a sight glass where the clarity can be observed. It is convenient to have the samplers and observation cylinders mounted on a stand on the operating floor near each filter.

Water should not be allowed to pass through a filter too quickly, and control of the rate calls for a gauge which shows (and desirably records also) the rate at which the water is entering each filter. When the rate becomes too great, the entrance flow can be checked by hand; but most modern filter plants have rate-of-flow controllers which do this automatically.

As suspended matter collects in the filter, it requires more head to force the water through; and when the head reaches a certain maximum the filter should be washed. A sudden drop in this head probably means a crack in the filter sand, break in the drainage system or other defect which should be remedied at once. It therefore is desirable to know at all times just what head is lost in the filter. This can be effected by means of two floats, one in a float tube connected with the water on top of the filter, the other in a tube connected to the effluent pipe. Vertical rods from these, carrying pointers up and down a scale, will give the distances of the floats above and below an assumed datum. Or a cord connecting the two floats and passing around a drum between them will move a pointer around a dial. More compact and convenient devices are available, however.

In addition to these, a plant which is at all complete includes meters (preferably recording) measuring the inflow to the filter, the wash water used, and (as a check) the total effluent; also rate-of-flow indicating apparatus for each filter; recording gauges giving height of water in clear water reservoir and in the wash-water tank. Various forms of these will be described in following pages.

The designing of filter plants has become more or less standardized, especially as to essential elements, and some companies (Roberts Filter Mfg. Co., E. W. Bacharach & Co. and Norwood Engineering Co.) specialize in furnishing a complete plant, as simple or with as many automatic and labor saving devices as desired.



"Infilco" operating table.

Removing Hardness

Softening water is commonly effected by one of two processes: (1) addition of chemicals (lime and soda ash in most cases) which render insoluble the bicarbonates of calcium and magnesium which are in solution in the water, and which are then removed by sedimentation and filtration; or (2) passing the water through a bed of granular zeolite, which absorbs the calcium and magnesium.

Lime-Soda Process

In this process the water is treated either hot or cold; the latter always for potable purposes. For boiler use there are advantages in heating the water before treatment; the reactions are more complete and take place more quickly, thus making possible smaller reaction and sedimentation tanks; the softening is more complete, and dissolved gases are removed; and the heat is not wasted if the water be used at once in the boiler. However, with the cold process it is practicable to reduce the hardness to approximately 5 grains per gallon, which is lower than is generally desired for a potable supply.

The mixing of the lime with the water must generally be continued for a longer period than mixing of coagulants, and the amount of sludge collecting is much greater; therefore the capacities of the mixers and tanks must be proportioned accordingly. Also, the applying of the exact amount of chemical called for by the character of the water being treated is more important, and therefore the chemical feed needs special attention.

Lime-softened water is not stable and is likely to cause deposits on pipes, meters, etc., and on the sand grains in the filters. It is therefore desirable to recarbonate it, for which purpose carbon dioxide gas is commonly used, produced by burning coke, gas, oil or pulverized coal in a suitable furnace, and diffusing the gas into the water through a grid after the water has passed through the sedimentation basin but before it reaches the filter.

Soluble carbonates of magnesium often remain in lime-soda softened water, and these can be removed by excess lime treatment, split treatment, excess lime followed by recarbonation, substitution of zeolite for soda ash; or by excess lime, mixing and settling, recarbonation, mixing and settling and recarbonating again, and filtering.

It may be necessary to use 250 to 1,000 lb. of lime and soda ash per million gallons of water treated, or a ton a day for a population of 50,000 more or less. For handling this large amount from car, boat or truck to bin (which is generally elevated for gravity feed), conveyors are desirable. (See "Handling Chemicals.")

Manufacturers of this type of equipment make special mixing tanks for lime softening, which keep the solution (or rather, milk of lime) continuously mixed to maintain a uniform known strength throughout the tank. It is also necessary that the solution be thoroughly mixed with the water to be softened, and that the dose per gallon be maintained as that desired. Provision for removing sludge from the mixer at intervals is necessary, this sludge being about the consistency of thick whitewash.

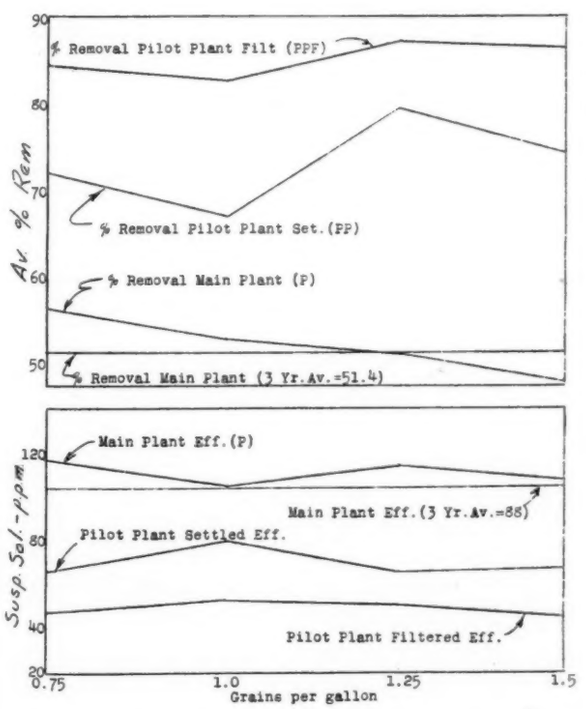
(To be continued)

Filtering Precipitated Sewage at Grand Rapids

IN STUDYING how to decrease pollution of the Grand River by the sewage of Grand Rapids, which received primary treatment only—plain sedimentation and sludge digestion with chlorination of the effluent—experiments were conducted in 1934 and 1935 with chemical treatment, using a coagulation tank 5′ 10″ diameter and 4′ 5″ deep provided with two wooden horizontal paddles, and a vertical-flow settling tank of 1900 gallons capacity. Sewage was run through this plant at rates varying from 15 to 60 gpm. and coagulants used varying from 0.5 to 2.0 gr. per gal., the coagulants used being ferric chloride, ferric sulphate and alum. Coagulation periods varied from 15 min. to 60 min. and detention periods from 32 to 127 min.

This plant was operated 8 hrs. a day 5 days a week. While this intermittent operation was more practicable than it would have been with biological treatment, it probably helps to explain the apparent inconsistency of many of the results. There are, however, several conclusions which seem to be warranted; and one concerning which few inconsistencies appear—the filtering of the settling plant effluent.

The settling tank, which was radial flow, was built with an upward-flow sand filter extending around half the circumference, so that half the effluent passed through it and half was unfiltered. This filter was a trough 12″ wide with a screen bottom, containing 3 in. of washed sand of the size retained on a 16-mesh screen. Each morning, when sewage was admitted to the plant for its 8-hr. run, the sand was hand raked, washed and leveled off before the sewage rose to its level. It was often necessary to lower the head in the tank in order to wash the sand in the middle of the day, but equally as often the morning cleaning only was necessary. The filtered effluent always contained less suspended matter than the unfiltered. The average of the results showed suspended solids removal of 64.3% by the settling tank only and 81.8% by tank followed by filter, leaving a solids content in the effluent averaging about 28 ppm. All B.O.D. tests indicate substantial reduction by the filter.


Av % Rem
% Removal Pilot Plant Filt (PPF)
% Removal Pilot Plant Set. (PP)
% Removal Main Plant (P)
% Removal Main Plant (3 Yr. Av. = 51.4)
Susp. Sol. - ppm.
Main Plant Eff. (P)
Main Plant Eff. (3 Yr. Av. = 88)
Pilot Plant Settled Eff.
Pilot Plant Filtered Eff.
Grains per gallon

Result of ferric chloride coagulation, showing effect of filter.

Another advantage of the filter was a smoothing out of peaks and valleys in the percent-removal graphs of the unfiltered effluents, due possibly to variations in flocculating effectiveness, in character of sewage and other causes.

Among conclusions by Naseeb G. Damoose, drawn from these experiments but not so definitely established by them, one is that 15 min. is the most desirable coagulation period, and 2 hrs. the most desirable period for retention in the sedimentation tank. Another is that ferric chloride is at least not exceeded in efficiency by either ferric sulphate or alum, when the dose is 1.5 gr. per gallon; and on the basis of combined efficiency and cost, ferric chloride seems to be preferable.

The cost of chemical treatment for 24,700,000 gpd is estimated to include $75,000 for housing, chemicals and equipment and flocculating basin, on which is based an annual interest and retiring cost of $5,520. Two additional operators would cost $3,000. An assumed dose of 1.12 gr. per gal. of ferric chloride, 40% solution at $17.40 a ton would cost $85.96 a day. To offset this, the chlorine demand of the effluent would be reduced from $91.92 a day to $57.54. Annual operating costs would vary with the number of hours per year during which chemicals are used. It was assumed that 16 hrs. a day for 184 days a year would be sufficient to prevent impermissible pollution of the river and the annual cost of this was estimated to be $26,274.

Grand Rapids has for some time been making and selling processed sludge as fertilizer under the name "Rapidgro" and it is stated that "at no time in the past has all the available sludge been processed and sold as fertilizer, in spite of the fact that, more often than not, demand for this material has been greater than the supply" although no real effort has been made to promote its use by advertising or otherwise. It was believed that this fertilizer could be sold at $7 a ton. Also that the additional gas resulting from increased sludge could be used and is worth at least 1 ct. per kwh produced. These two credits would total $7,305 for 184 days operation, leaving a net cost of $18,968.

Novel Stop Signs

Police in Coral Gables, Florida, are installing new stop signs which can be felt as well as seen. Raised letters about two inches high and covering most of the width of the street are made out of concrete and tar and painted a bright yellow. A long bar of the same material and color warns the driver by a slight jolt, in case he should miss seeing the sign.

Buttles Street in Midland, Michigan before and after curbing and stabilization. Except for occasional light blading the street is maintained with calcium chloride only, providing a dustless all-weather hard surface.

Stabilization for Street Improvement

THE need for improvement of many of the secondary streets in cities, towns and villages, in order to eliminate dust and mud, has created a demand for some form of low-cost surfacing which will answer this purpose.

Research in the highway field, during the past few years, has developed tests and methods which make possible the combining of gravel, stone or slag aggregates with binder-soil (clay or mixtures of clay with sand or silt) and the introduction and retention of the proper moisture content, to form very dense, well-bonded surfaces. By the proper gradation of particle sizes and compaction under rollers and traffic in the presence of the correct amount of moisture, such stabilized surfacing material attains a unit weight of 140 to 150 lbs. per cubic foot, which equals that of cement concrete.

From 6 to 10 per cent of water is present in the mixture at the time of construction, and the retention of this moisture is accomplished by the admixture of flake calcium chloride at the rate of 18 lbs. per cubic yard. This deliquescent chemical serves to retard evaporation and to maintain that damp condition which is necessary to prevent ravelling of the surface under traffic and weathering. Subsequently, light surface applications of calcium chloride are made, as a maintenance measure, to preserve this moisture bond.

Soil-stabilized surfacing is adequate to give satisfactory all-weather service on secondary streets. It may also be utilized later, if desired, as a base for thin bituminous coverings, or other more costly surfacing materials. In fact, base stabilization is rapidly becoming standard practice and many engineers favor the idea of deferring the covering of such stabilized bases for one or more years, in order that the bases may attain maximum density under traffic and to allow for the correction of any subgrade settlements. With occasional surface applications of calcium chloride and proper attention given to patching and blading after prolonged rains, such stabilized wearing courses may be made to serve secondary street traffic for years at a moderate maintenance cost. Stabilized wearing courses may be constructed by either the road-mix or plant-mix method.

Road-Mix Method

This has been the more commonly used method and consists essentially of the following steps:

(1) Distributing the binder-soil (clay) along the shoulder or roadway and allowing it to air-dry so that it can be crushed by rollers, blading or traffic.
(2) Spreading the graded gravel, stone or slag over the roadway and blading the pulverized clay evenly over it.
(3) Distributing the required amount of flake calcium chloride over the clay aggregate.
(4) Blading all ingredients back and forth across the roadway until thoroughly mixed.
(5) Adding water and continuing the blading until the mixture is thoroughly moistened.
(6) Spreading to proper formation and rolling.

The road-mix method is especially useful in stabilizing existing traffic bound streets where the aggregate is loose and dusty. The process is the same as previously described, except that it is often necessary to scarify the existing road metal to a depth of about 3 inches, and possibly add some new aggregate in order to have a reasonably good gradation of sizes.

Plant-Mix Method

The mixing of the proper proportions of aggregate, clay, calcium chloride and water in a central plant and delivering the completed mixture to the roadway, ready to be spread and rolled, has been a development of the past year. This method is particularly adapted to municipal work, and it has the following advantages over road-mix:

(1) A more uniform mixture.
(2) Less delay on account of unfavorable weather conditions. (Prolonged rainy periods prevent the efficient handling of clay in road-mixing).
(3) Less interruption of traffic.
(4) Greater convenience and less cost of supplying the necessary water.
(5) Elimination, in municipal work, of much of the difficulty of blading over man-holes and cross-walks; also of the inefficiency of equipment operation in blade-mixing on short projects.
(6) Less equipment needed on the road.

The plant equipment required for producing a stabilized mixture consists of a unit for pulverizing the clay, and a system of hoppers and conveyors for feeding controlled quantities of graded aggregate, clay and calcium chloride into a pug-mill, where water is added.

Standard clay-handling units designed for brick and tile mills are utilized. They consist of two pairs of rolls, the upper one of which has knives attached, while the lower pair are both smooth. The clay is not artificially dried and while fairly dry clay is preferable it has been found possible to break up clay having as much as 20 per cent moisture.

The pug-mill is of the continuous mixer type which both mixes and conveys the material to the outlet where it is elevated into a storage hopper for delivery.

Many commercial aggregates producers have become interested in making stabilized mixtures, not only because of the present general interest in secondary road and street improvement, but also because in many cases the strippings from pits and quarries consist of suitable binder-soil. This enables them to utilize what has prevously been a waste product. It is anticipated that their chief market will be, at first, in municipal and suburban areas.

Careful control is essential to best results in either a road-mix or plant mix. The quantity of clay to be added is predetermined by tests which measure the cohesive value of the soil fines. Care must be taken to avoid an excess of soil fines which would over-fill the voids in the coarser aggregate and cause the latter to lose its frictional stability.

What Municipalities Have Done

The following is a brief description of the stabilization work done in a few municipalities:

Lansing, Michigan, has a considerable mileage of gravel streets which have been maintained by blading and by sprinkling frequently to alleviate the dust nuisance. During the summer seasons, an undesirable amount of loose gravel usually developed on these surfaces. While the city is carrying on an annual program of oil-mat construction on these streets, it will probably be 5 to 10 years before all of them can be so improved. It was the desire of J. C. Brandimore, Superintendent of Public Works, to provide an improved intermediate service for the public and to eliminate part of his sprinkling and blading work.

Accordingly, in 1934, he stabilized 4 blocks with clay and calcium chloride and was so impressed with the merit of this type of improvement that he proceeded with about 18 or 20 additional blocks in 1935. This work was all done by the road-mix method and very little new gravel was added. The existing gravel was scarified to a depth of about 3 inches where necessary, and the clay, calcium chloride and water were added and mixed by blading.

Mr. Brandimore found that stabilization reduced his blading costs about 75%. He was able to keep these stabilized streets dustless with calcium chloride applications at a cost of about $12.50 per block per year, while sprinkling cost about $15.00 per block per year. He has also found that, in sprinkling, if he used enough water to lay the dust thoroughly, the water tended to form in small pools, which traffic soon developed into larger holes, and increased the maintenance cost.

At Ames, Iowa, in 1935, City Manager John H. Ames improved about 3 miles of residence streets, 24 feet wide, by constructing concrete curb and gutter, a 3-inch base course of pit-run gravel or cinders, followed by a 3-inch course of stabilized gravel in which the clay, calcium chloride and water were added to, and mixed with the gravel in a concrete mixer at a central yard. The clay was obtained from an idle tile mill and delivered to the mixing yard in a very dry and finely pulverized condition. This was one of the first plant-mix operations in the country, for this type of surfacing, and it was an outstanding success. The material, when spread on the streets, compacted rapidly into an excellent wearing course. Late in the summer, Mr. Ames completed his original plan by covering these stabilized surfaces with thin bituminous wearing courses. The stabilized course, however, was giving excellent service and was pleasing to the residents of these streets. It is probable that if the initial plans had not included bituminous coverings, none would have been placed for at least a year and possibly several years.

The City of Detroit, Michigan, has about 700 miles of secondary, unpaved streets on some of which have been placed traffic-bound surfaces of stone, slag or cinders. Dust, mud and roughness present a serious maintenance problem on this mileage, and C. D. Warner, Supt. of Maintenance in the Department of Public Works, has, during the past year, undertaken a program to better these conditions.

This program, now in progress, consists of grading and placing drainage structures and a 4-inch stabilized slab wearing course on 50 miles of streets; also reconditioning and adding some stabilized slag to another 115 miles of old stone and slag macadam. Mr. Warner plans to cover nearly all of this mileage, at some later date, with bituminous treatments.

With the exception of supervision and equipment charges this work is being financed by Federal funds, as W.P.A. projects. About 11,000 men are being employed. The stabilized slag is produced in a central mixing plant at the rate of 100 tons per hour. This plant was set up on the site of an abandoned brick plant and practically all of the clay-processing machinery of the old brick plant was utilized. Pulverized clay, flake calcium chloride and water were mixed with the graded slag in a pug-mill and the finished mixture trucked to the streets. While progress has been somewhat retarded by unfavorable weather conditions, about 25,000 tons of stabilized slag have been laid.

Many other municipalities have used soil-stabilized aggregates as a low-cost surfacing for secondary streets, and the possibilities for this type of improvement are almost unlimited. City and village officials everywhere have many minor residence streets on which the traffic does not, now, or may never, justify the expense of high type pavement; but these officials are recognizing the rights of traffic and of residents, on such streets, to some form of betterment which will eliminate dust and mud. This must be accomplished, in a majority of cases, within a limited budget, and stabilization will be the answer to many such street problems.

A residence street in Barberton, Ohio, before and after stabilization including concrete curb and gutter. The street is in perfect condition after 3 years use, having been maintained with calcium chloride and semi-annual shaping only.

The Decarie Incinerator at Hempstead, L. I.

Refuse Collection and Disposal in New York State

OUT of 44 villages in New York State covered in a recent report by the New York State Conference of Mayors, from which the figures in this article are taken, 22 have municipal and 11 contract collection of ashes, garbage and rubbish. Two have part municipal and part contract; 2 have no collection service of any kind; and the remainder combine municipal and contract collection. Of 43 cities reporting, 17 have municipal and 7 contract collection of ashes, garbage and rubbish; 5 have part municipal and part contract; 8 have garbage collection only, 6 by contract and 2 by the municipality. The remainder have various combinations.

Ten villages report having separate sanitation departments, of which eight are concerned only with ashes, garbage and rubbish. Of 19 having municipal collection, the work is administered by the Department of Public Works in 10, by the street department in 7, by the engineer in 1 and by the highway department in 1. Of 5 villages having contract collection, the work in 4 is under the village trustees, and under the engineer in 1.

Of 42 cities, 8 have separate sanitation departments, 4 of which are concerned with ashes, garbage and rubbish. Of 18 cities with municipal collection, the work is under the Department of Public Works in 11, the street department in 4, and under the following 1 each: Maintenance and Operation, Public Service, and Public Safety. Where contract collection is employed, supervision is under the Health Department in 6, the Department of Public Works in 4, and the Mayor or Council in 3.

All municipally operated systems are administered by engineering departments, such as Public Works, Streets, etc.

For the 87 municipalities, practice is shown in the accompanying table:

	Municipal	*Contract*	*Private*	*None*
Ashes	45	20	18	4
Garbage	44	38	5	0
Rubbish	48	21	15	3

In contract collection, the lengths of contracts in years.

	1	*2*	*3*	*4*	*5*
Villages	11	—	5	—	1
Cities	5	3	6	1	4

Data regarding collection combinations

Combined Collection

Materials	*Villages*	*Cities*	*Total*
Ashes and incombustible rubbish	11	13	24
Garbage and incombustible rubbish	10	11	21
Ashes, garbage and rubbish	11	6	17
Ashes and rubbish	6	10	16
Garbage and rubbish	5	1	6
Ashes and garbage	1	0	1

Separate Collection

Garbage	14	25	39
Ashes	7	5	12
Rubbish	5	3	8
Rubbish (combustible)	1	3	4
Rubbish (incombustible)	0	2	2

Information regarding requirement of wrapping garbage in paper was gathered; 33% (or 25) of the cities and villages require such wrapping, while 67% (or 51) do not require it.

Metal containers for garbage were required by 56 of 66 cities and villages reporting; metal containers for ashes were required by 38 of 52 reporting. Frequencies of collection were reported as follows:

Garbage Collection

Collections per week	*1*	*1-2**	*2*	*3*	*2-3*	*3 or more*
Villages	7	5	17	6	3	2
Cities	14	8	10	3	0	3
Total	21	13	27	9	3	5

* Winter-summer.

Ash Collection

	1	*1-2**	*2-1**	*2*	*2-3**	*3*	*3-1**	*3 or more*
Villages	9	3	5	11	1	4	1	1
Cities	12	1	1	8	0	1	0	1
Total	21	4	6	19	1	5	1	2

* Winter-summer.

Disposal data are as follows:

Ashes

	Villages	*Cities*	*Total*
Dumping	24	20	44
Used in fill	13	11	24

Garbage

Dumping	16*	9†	25
Hog Feeding	8*	11†‡	19
Incineration	15	15	30
Reduction	0	2	2
Burial, plowing, etc.	1	5‡	6

* One village part hog feeding, part dumping.
† Three cities part hog feeding, part dumping.
‡ One city part hog feeding, part ploughed under.

Rubbish

Dumping	23	17	40
Incineration	15	15	30

Refuse Disposal

Dumping.—Of 43 villages and 41 cities in New York State, 19 villages and 12 cities, dump all refuse; the term dumping including trench and cover, ploughing under, sanitary fill and ordinary dumping. These dumps were fenced in 32% of the places and unfenced in 68%. On 71% of the dumps, combustible material was burned. Precautions against rats, fly and mosquito breeding, etc., are reported by 58% of the users; complaints of odors were reported at 46% of the dumps.

Hog Feeding.—In 19 municipalities (24% of those reporting) all or part of the garbage is fed to hogs. As a rule the hog farms are owned privately, and the garbage collected by contract is either sold by the collector or he runs the hog farm also. In 2 municipalities it is collected by municipal forces and sold; in one sales are on a yearly basis; the other municipality gets $1 per load of about 1½ tons. In no case is the garbage sterilized before it is sold; in most instances no supplementary food is used. It is estimated that 50% of the garbage remains uneaten.

Reduction.—Only two cities, Rochester and Syracuse, employ reduction. In the former plant, about 50 pounds of grease and 400 pounds of tankage are obtained per ton of green garbage. The loss of naphtha per ton of garbage is about 2½ gallons. The net cost per ton of disposal of green garbage for the period 1922-33 averages $3.47.

No operation data are reported for the Syracuse plant. Both cities report complete satisfaction, no odor and no complaints.

Incineration.—The garbage and combustible rubbish of 17 villages and 15 cities are incinerated: 2 cities incinerate rubbish only. In all but 1 city and 1 village, in which the plants are owned and operated by contractors, the incinerators are municipally owned. In 2 cities, the incinerators are operated by contract; in the remainder by the municipality. In a few instances, refuse from one municipality is burned in the plant owned by another.

While in almost every case, incinerators are operated six days a week, the hours per day of operation depends upon many other factors. Only a few of the plants operate 24 hours a day regularly.

Of 22 cities and villages reporting, 7 separate combustible and incombustible refuse; 11 do not; and 4 report partial separation. In some cases, separation is attained during collection; in others as an adjunct of salvage. Bottles, crockery and metal should not be fed to the furnace; tin cans should be. The first mentioned will or may melt and clog the grates, whereas passing tin cans through the fire destroys organic matter in them and melts off the tin, resulting in early destruction on the dump.

Weight of Refuse

More than 50% of the municipalities reporting—8 cities and 9 villages—weigh the refuse as it is brought to the incinerator, while 2 villages and 5 cities do not. In 11 municipalities the material burned per day was 31% greater in the summer than in the winter.

The average yearly per capita quantity of refuse was computed for each municipality furnishing data, and the average of these averages are given below.

Material	*No. Mun.*	*Av. Lbs.*	*Max.*	*Min.*
Ashes, Garbage and Rubbish	5	1700	2153	1270
Garbage and Combustible Rubbish	13	614	1205	263
Garbage and Rubbish	4	766	1030	343
Garbage	6	247	427	159

At no plant was it necessary to use auxiliary fuel continuously. Of 22 municipalities, 11 report that auxiliary fuel is used, but evidently some of these consider auxiliary fuel to include boxes, wood, crates and paper sorted out of the refuse and used for starting or aiding the fire. Sawdust and crankcase oil are used successfully in some places; others find them unsatisfactory. Nozzles provide the best method of using crankcase oil.

Only 2 municipalities use heat generated by burning refuse on a larger scale. Rochester generates steam for use in the reduction plant. Niagara Falls uses steam produced in this way for operating an asphalt plant. Other municipalities use the heat produced to heat the plant, a garage, water for showers or for cleaning the vehicles.

Forced draft is reported by 23 of 28 places, while 17 out of 27 use recording pyrometers. The temperatures at which the plants are operated are as follows, in Fahrenheit:

	Average	*Maximum*	*Minimum*
Average	1554	2000	900
Maximum	2018	2600	1700
Minimum	1286	1800	600

Most of the municipalities incinerate dead animals; a few incinerate sewage screenings and sludge. In one case, burning of sludge was abandoned because of smoke nuisance.

The average cost of these incinerators per rated ton of capacity, excluding land, is $1,119 for villages and $977 for cities. The average of all plants is $1,045. The lowest figure is $414; the highest $1,917.

Costs of incineration do not seem to be available. The cost of collection and disposal, disregarding detail practices, in 9 cities with incinerators, averages $3.36 per capita per year.

Salvaging

A number of cities sell the privilege of salvaging salable refuse, but the income is usually very small. The main advantage lies in the greater degree of control over the work when it is handled on a business basis. Paper, magazines, books, metals, rubber, bottles, rags, cans, leather, glass, etc., constitute the materials generally salvaged. Rochester does the salvaging on a municipal basis, but the returns do not pay the cost of the work.

Notes on Use of Activated Carbon in Water Treatment

A continuation from our March issue of these data

QUINCY, Ill., prechlorinates and preammoniates, with a ratio of 3:1, with a residual of about 0.5 ppm. reaching the filters and 0.4 ppm. passing through. From 20 to 60 pounds per mg. of activated carbon are added to the mixing chamber. W. R. Gelston, supt.

Activated carbon, fed dry, is applied to the mixing chambers at Vandalia, Ill., at the rate of 20 pounds per mg. Ned Atkinson, supt.

Split feed is employed by White Hall, Ill., with 10 pounds per mg. of carbon applied to the mixing chambers, and 5 pounds to the filters. Dry feed is used. G. T. Vandaveer, supt.

Wilmette, Ill., prechlorinates and uses 30 pounds of carbon per mg. in the mixing chamber, fed dry. W. M. Olson, supt. of filtration.

Batesville, Ind., prechlorinates and preammoniates, with a ratio of 1:3, and post-chlorinates in the summer. When carbon is used, 38 pounds per mg. are applied to the mixing chamber. Harry Schwier, mgr.

Washington, Ind., mixes activated carbon with alum, using a dose of about 6 pounds per mg. W. J Perrine, supt.

Activated carbon is fed in solution with filter wash water in Burlington, Ia., using 3.5 pounds per mg. Mark E. Driftmier, asst. supt.

Prechlorination and preammoniation are used at Cedar Rapids, Ia., ratio 1:3. As needed, 30 to 150 pounds per mg. of carbon are applied to the mixing chamber by solution feed. H. F. Blomquist. supt.

Creston, Ia., uses 5 pounds per mg. of activated carbon applied in the mixing chamber. fed as solution. Arthur K. Olsen, supt.

Osceola, Ia., uses 10 pounds per mg. of carbon, applied to mixing chamber. Fed dry. John M. Mullen, clerk.

Split feed is used by Horton, Kans., with 5 pounds per mg. of activated carbon going to the mixing chambers and 3 pounds per mg. to the filters. H. L. Lingo, supt.

Lawrence, Kans., prechlorinates and preammoniates, ratio 1:4, maintaining a residual of 0.1 ppm. at the filters, and also post-chlorinates, so as to maintain 0.3 ppm residual. Activated carbon is used at the rate of 25 pounds per mg., applied by dry feed to the mixing chamber. Frank E. Willey, supt.

From 3 to 50 pounds of activated carbon per mg. is used at Ashland, Ky., using dry feed, and applying to the mixing chamber. J. P. Brownstead, supt.

From 1 to 8 pounds of activated carbon is applied per mg. of water at the mixing chamber in Paris, Ky., and from 2 to 4 pounds per mg. is applied to the filters. Harry J. Achee, gen. supt.

Cumberland, Md., uses carbon only in emergency, then generally using 30 pounds per mg., fed in solution. C. J. Bruce, supt.

A dose of 5 pounds per mg. of carbon is added to the mixing chamber at Midland, Mich. P. Stegeman, supt.

Use of activated carbon at Mt. Clemens, Mich., depends on the condition of the water. It is used at times. No rate of dosage reported. J. A. Keils, supt.

St. Joseph, Mich., uses 8.2 pounds per mg. of carbon, added at the mixing chamber by solution feed. D. E. Bicknell, supt. P. W.

Using a dry feed to a wet funnel, Minneapolis, Minn., adds 14 grains per gallon of activated carbon to the filters. Treatment is not continuous. J. A Jensen, supt.

Activated carbon is applied to the filters of the Springfield, Mo., plant at the rate of 7 pounds per mg., fed in solution. W. H. Dewey, supt.

When needed, 7 to 15 pounds of carbon are added per mg. at the mixing chamber, fed dry, at Billings, Mont. A. L. Hewett, supt.

Occasional use of activated carbon is reported by Elmira, N. Y. About 40 pounds per mg. is applied to the water flowing to the filters at such times. H. M. Beardsley, general mgr.

At Ossining, N. Y., an ammonia-chlorine ratio of 1:4 is maintained; activated carbon is used, applied in the mixing chamber at the rate of 15 to 20 pounds per mg., fed dry. Wallace T. Miller, supt.

At Poughkeepsie, N. Y., prechlorination and preammoniation (1:3) with post-chlorination are employed; activated carbon is used periodically, applied to the mixing chamber in doses of 2½ to 6 pounds per mg., fed dry. Thomas F. Lawlor, supt.

Prechlorination and preammoniation, ratio 1:2, with post-chlorination are reported at Tonawanda, N. Y. Carbon is also used, the mixing chamber being dosed at the rate of 6 pounds per mg., fed dry. F. E. Chase, chief engr.

Waterford, N. Y., prechlorinates and uses activated carbon at times, adding up to 10 parts per million to the filters, using dry feed. R. G. Yaxley, supt.

Wellsville, N. Y., uses 6 to 10 pounds of carbon, applied by dry feed, to the mixing chamber. E. J. Rowe, supt.

A solution feed of activated carbon, with 4 pounds per mg. to the mixing chamber, is used at Albemarle, N. C. G. S. Moore, supt.

Wilmington, N. C., doses the water flowing to the filters with 2 pounds of carbon per mg. McKean Maffit. supt.

A "very small" dosage of carbon, mixed with alum, is reported by Statesville, N. C., which is just finishing important additions to its plant. DeKalb Kennerly, supt.

Conneaut, O., uses 8 pounds per mg. of carbon, applied as a solution to the mixing chamber. Lee Harvey, supt.

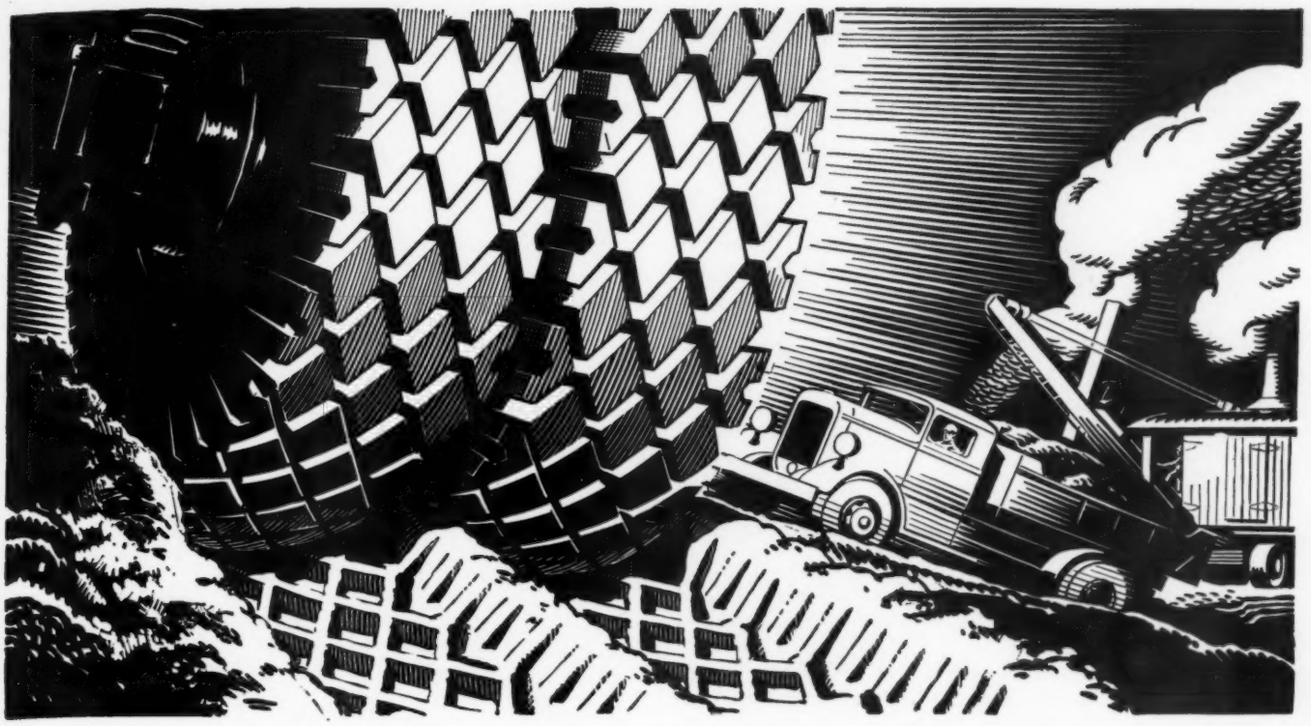
Eaton, O., mixes carbon with alum, using up to 50 pounds per mg. J. H. Beatty, supt.

Using alum solution feed, 20 pounds of carbon per mg. is the dosage at Lima, O. E. E. Smith, gen. supt.

Medina, O., uses alum when necessary, applying it to the filters at the rate of 23 pounds per mg. A. H. Fretter, supt.

A dose of 10 pounds per mg. of activated carbon is used at Danville, Pa. LeRoy Dietrich, supt.

Huntingdon, Pa., uses carbon part of the time. When



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used, 8 pounds per mg. is applied by dry feed to the mixing chamber. J. G. Dell, supt.

Dry feed dosage of 20 pounds per mg. of carbon is reported by Morrisville, Pa. Harry H. Lee, Jr., borough engr.

An average dose of 1.8 ppm. of activated carbon is applied to the intake well at Sayre, Pa., using a dry feed. Chas. C. West, gen. mgr.

Charleston, S. C., adds 11 pounds of carbon to the mixing chamber, using solution feed. James E. Gibson, mgr. and engr.

Aberdeen, S. D., applies carbon at the mixing chamber by dry feed, varying the dose from 8 to 75 pounds per mg. Prechlorination and preammoniation are also used; ratio 3:1. J. G. Colahan, supt.

McMinnville, Tenn., applies activated carbon mixed with alum (4%). No dosage reported. Chester Womack, supt.

Seasonal use of carbon is reported by Murfreesboro, Tenn. When used, it is mixed with alum (4%). J. B. Farmer, supt.

South Boston, Va., mixes activated carbon with alum (1%) and applies at the rate of 8 pounds per mg., and adds 2 pounds to the filters after washing. P. H. Johnson, Jr., supt.

Sisterville, W. Va., adds 10 pounds per mg. of activated carbon at the mixing chamber, solution feed. C. R. Sandy, street and water commissioner.

A dose of 0.095 grams per gallon of carbon is applied to the water flowing to the filters, using dry feed, at Williamson, W. Va. F. M. Offutt, supt.

Activated carbon and alum are mixed (1% of carbon) at Menasha, Wisc. Chlorine-ammonia ratio is 1:6. J. H. Kuester, supt.

Carbon and alum are mixed at Two Rivers, Wisc., using 2% of carbon, and a total carbon dose of 25 to 100 pounds per mg. Alfred O. Allie, auditor.

Loveland, Colo., doses the water flowing to the filter with 1 pound per mg. of activated carbon, fed dry. Wm. C. Davis, Jr., operator.

Evanston, Ill., using solution feed, treats water with carbon at rates of 5 to 30 pounds per mg. W. W. Polk, supt. and chief engr.

Activated carbon is fed with lime at Gillespie, Ill. Dose is 10 pounds per mg. Charles Tillman, clerk.

A dose of 5 pounds per mg. of carbon is used at Johnston City, Ill., applied at the mixing chamber. John B. Gustat, supt.

Paris, Ill., adds 10 parts per million of carbon to water flowing to the filters; solution feed. Chlorine-ammonia ratio 1:2. Joe W. Wadin, commissioner.

A dose of 1½ pounds per mg. of carbon, fed dry, and applied at mixing chamber, is used at Staunton, Ill. Joe Schwandnev, supt.

Ames, Ia., used 8 to 15 pounds of carbon, fed in solution, per mg. at the mixing chambers. C. C. McCarthy, engr.

Carbon is added to water flowing to filters at rate of 2 pounds per mg., fed dry. J. A. Dunkel, city mgr.

Coffeyville, Kans., uses a small amount of activated carbon, applying it to the filters at the rate of 6 to 10 pounds per mg., in solution. William O'Day, chief engr.

Louisville, Ky., uses a 1:4 ammonia-chlorine ratio, and adds activated carbon intermittently to the mixing chamber at the rate of 8 to 20 pounds per mg., fed dry. F. H. Stover, chem. and bact.

The Salem and Beverly Supply, Mass., R. P. Johnson, supt. of filtration, uses about 17 pounds of carbon per mg., mixing it with the alum (6%).

At Bartlesville, Okla., carbon is used part of the time. Dose is applied as solution, at rate of 10 pounds per mg., to mixing chamber. C. E. Perkins, supt.

Carbon and alum, mixed 1% to 6%, and fed dry, are used at Beaver Falls, Pa. Dose is 25 pounds per mg. W. U. Gallaher, supt.

Indiana, Pa., uses activated carbon at times, in solution, 2 to 4 pounds per mg. H. W. Pharaoh, mgr.

Knoxville, Tenn., reports use of carbon at times of acute taste troubles. Dose is 5 to 10 pounds per mg. to both mixing chamber and filters. dry feed. Ammonia-chlorine ratio 1:2; residual to filter 0.15 ppm. W. B. Whitaker, engr.

Denison, Tex., feeds carbon mixed with lime, using 10 to 20 pounds per mg. A. M. Brenneke, city engr.

Richmond, Va., adds an average of 1.5 pounds per mg. to the filters. Geo. H. Whitfield, director.

Weston, W. Va., average dose is 15 pounds per mg. of carbon at the mixing chamber and also applies carbon to the filters. Fed dry. T. J. Blair, Jr., mgr.

Appleton, Wisc., maintains an average dose of 12 pounds per mg. in water flowing to filters; dry feed. W. U. Gallaher, supt.

To Encourage the Use of Cotton in Highway Construction

For the purpose of stimulating field tests of new uses of cotton in highway construction, manufactured cotton fabric for use as a reinforcement membrane in bituminous surface treated highways and cotton mats for use in curing concrete highways will be furnished by the Department of Agriculture upon request to state highway departments so that they may be tested in widespread use under all climatic conditions. If the results of these tests are as favorable as certain preliminary trials along these lines have indicated, these new fields of use would require large quantities of cotton in the future.

This project involves an allocation of $1,300,000. Under the program as approved by the Secretary of Agriculture, cotton fabric for bituminous surfaced roads will be provided for a maximum of 1,000 miles of this type of road. An aggregate of approximately 80,000 cotton mats for curing concrete in highway construction also will be made available for an average of at least three projects in each state.

The project which has the approval of the Bureau of Public Roads will be administered jointly by the Bureau of Public Roads and the Agricultural Adjustment Administration.

Experimental work in the development of cotton mats for curing concrete has been carried out by the Bureau of Public Roads and the Texas State Highway Department. In these experiments the mats have proved to be satisfactory and economical for this purpose. In the present program each state highway department may receive sufficient mats for demonstrational projects.

Experimental work in the use of coarse cotton fabric as a reinforcement membrane in bituminous surface treated roads has been under way for a number of years in South Carolina, and some experimental projects have also been undertaken in other states, as reported some months ago in *Public Works*. The cotton reinforcement membrane is used to prolong the life of the surface and reduce maintenance costs by preventing the development of cracks and holes in the surface and edge failures.

In Three More Cities

THE NORTON CONTROLLED STRUCTURE PLATE

TOPEKA, Kansas has joined the long list of users of Norton Porous Plates while Springfield, Illinois and Pasadena, California—for many years users of this product—are to equip new plant extensions with the Norton Controlled Structure Plate.

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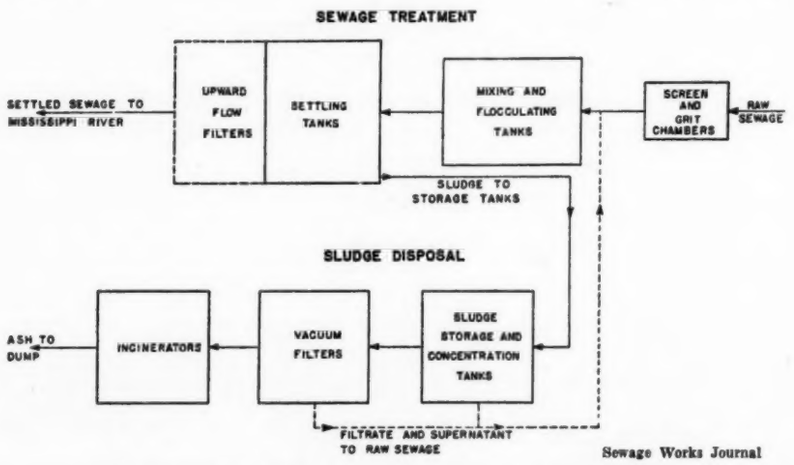
A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

BAR screens at Palo Alto, Calif., 1″ clear opening, hand cleaned, passed rags and sticks to such an extent that the pumps clogged 5 to 10 times a week; objects that passed the sewage pump often clogged the sludge pumps. With tomato canning season, tomato peelings accumulated so rapidly that operator spent one-third his time raking the screen. After 2 months of this it was decided to install a mechanically cleaned screen with ¾″ openings, and Link-Belt mechanically cleaned grit pit and screen was installed, electrically controlled and set to rake the screen every nine minutes. The trouble then largely disappeared. The amount of screenings and grit averages about 100 gpd, maximum 200 with cannery operating. Screenings are hauled twice a day to garbage dump and covered.[C3-8]

Cannery wastes at Palo Alto from daily use of 150 tons of tomatoes, 200 tons of peaches, 100 tons of apricots and 100 tons of spinach, carried by sewers to clarifier with mechanical sludge removal, formed scum of tomato peelings and peach fuzz 6″ or more thick which skimmer was unable to remove and hand removal with long handled rakes was necessary, and digester could not dispose of solids effectively. The difficulty has been practically remedied by covering cannery floor drains with 1″ mesh screens, and floor washings pass through two of these before reaching the sewer. Bad tomatoes, cuttings from defective ones and tomato and peach peelings pass through a "cyclone beater" which separates juice from fibrous material, the former passing to sewer through screen with 1/16″ openings. All screenings are hauled to the garbage dump. Sewage treatment plant now seems able to handle the liquid wastes. The average sewage flow is 1.545 mgd, with 2.5 mgd when cannery is running. The clarifier is 55′ diameter, average depth of water 8.2′. Digester has capacity of 52,000 cu. ft., heated to from 101° to 83°. Produces sludge of 94% water and 54% volatile matter content of dry solids, which is disposed of by lagooning.[C3-8]



Flow diagram of operation of Minneapolis-St. Paul treatment plant.

The **control house** of the Bristol, R. I., treatment plant contains several interesting features. The main floor is divided into three rooms, one containing the bar screens, chlorine tanks with hoisting equipment and scales, and lime feeder. Separated from this by a wall containing a large plate glass window is a laboratory; also in this wall is the panel on which is mounted the chlorinator, the gauges and controls being mounted on the laboratory side of the panel and the working parts on the screen room side. Similarly, while the platform of the chlorine scales is in the screen room, the balance arm is in the laboratory. These scales have 6,000 lb. capacity. Ton containers are handled by a hoist and trolley with the rail extending out doors for removing them direct from truck to scale platform.[H4-2]

The **Minneapolis-St. Paul treatment** plant has been definitely planned in its main features and most of its details, some contracts have been let, and it is hoped to have it in operation next spring. The basic features were adopted Dec. 19, 1935. For ten or eleven months of the year, it will operate by plain sedimentation. For one or two months chemical treatment will be added. Estimated cost, $3,375,000. During minimum flow in the river, 70% reduction in B.O.D. of sewage will be necessary, for 134 mgd from 910,000 population. Treatment without chemicals: Hand-cleaned bar racks, 6″ openings; mechanically cleaned bar screens, 1″ openings; grit chambers, flow velocity 0.45 to 1.18 ft. per sec., cleaned by mechanical scrapers and screenings washed in screw conveyors; screenings incinerated. Settling tanks with sludge scraping mechanisms, two sets in series (first set to be used for mixing and flocculating during chemical treatment), giving 2.43 hrs. detention. Sand filters (magnetite) may be added. Sludge pumped from tanks to storage and concentration tanks of 2 days' capacity, conditioned with chlorinated copperas and lime; dewatered by vacuum filters, at 5 lb. of dry solids per sq. ft. per hr. for 12 hr. per day; incinerated; type of incinerator not determined, capacity 180 tons of dry solids a day (including conditioning chemicals) for 12 hr. operation; estimated Btu, 6,800 per lb. Chlorination. During chemical treatment: 85 ppm chlorinated copperas, 75 ppm. lime and 16 ppm chlorine, mixed in first set of settling tanks, 3 min. air mixing and 23 min. flocculating; 120 min. in settling tanks. Sludge, 30 hr. in storage and concentration tanks. Vacuum filters, 4 lb. per sq. ft. per hr. for 24 hr. operation. Sludge, 4,650 Btu per lb. of dry solids. Otherwise treatment same as without chemicals. Chemicals in bulk unloaded by pneumatic conveyors; fed by gravimetric dry feeders; jet type solution chambers, continuous type lime slakers are provided.[C3-10]

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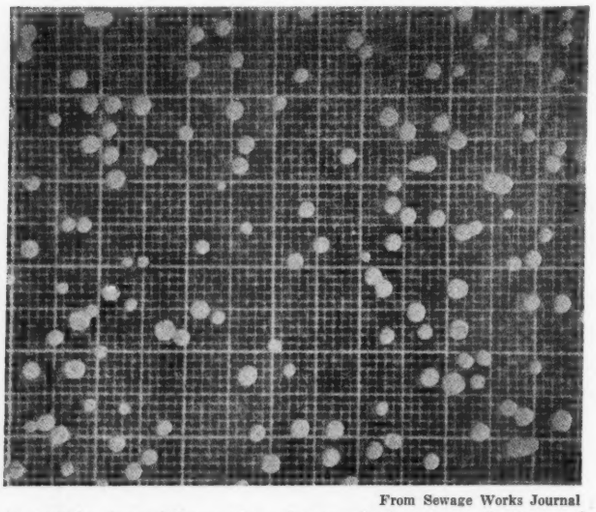
Diffuser plates in activated sludge plants in Texas in 1916 had a permeability rating of about 6; in 1920 in Milwaukee 9.0 to 12.9; in 1922 in Chicago, 10 to 12; in 1925 in Indianapolis, 10.5 to 15.5; in 1928 in Chicago, 11.7 to 18.5, the last still satisfactory after 7 years of service. In preparing to write specifications for the proposed new plants in Chicago, in 1934, investigation of the plates of three manufacturers led to the conclusions that diffuser plates giving uniform permeability rates when accurately tested will give uniform distributon of air in a tank, even with ratings as high as 67. There is a slight increase in bubble size with greatly increased permeability, and also with an increase in air rate. There is an increase of pressure loss through diffuser plates with use, which varies inversely as the permeability. A change in barometric pressure affects the permeability test, but not enough to be detected by ordinary test apparatus. The temperature of a diffuser plate is the most important factor affecting the permeability test. A change in the relative humidity of test air or room air has no detectable effect on permeability when the humidity is maintained under 71%.[C3-4]

Digesting garbage mixed with sewage, the garbage being ground and dumped into the sewer at the average rate of 82.3 tons a day, the sewage flow being 47.0 mgd., or garbage dry solids equivalent to 24% of the sewage sludge dry solids, was successful in Indianapolis in 1935. Conclusions reached were that "1—Daily charges of primary sludge, activated sludge and garbage, in which the volatile content of garbage solids was 33% of the total volatile solids, digested for nine days at 85° F., produced 562 cc. of gas (CO_2 content 32.7%) per gram of volatile added, with a resulting decrease in volatile solids of 59.9%. 2—It is absolutely necessary to submerge the material which collects at the surface of the tank. 3—Digestion takes place at a more rapid rate when garbage is present in a sludge mixture than in sludge alone. 4—The quantity of gas produced per unit of volatile garbage solids is at least twice that produced from primary and activated sludges."

Experiments conducted at the University of Illinois apparently showed that good results could not be obtained by dumping batches of garbage into the influent end of any type of continuously flowing sedimentation tank, or into the gas vents of an Imhoff tank. But when ground garbage was mixed with sewage before reaching the tank at the rate of one ton of wet garbage solids per million gallons of sewage, excellent results were obtained—the pH remained near or slightly above 7.0, volatile acids low, active gasification and practically no scum; however, an appreciable amount of garbage solids appear in the effluent and the BOD of this exceeds that of the influent. A digestion tank, temperature held at 90°, containing a ton of wet garbage to 77.5 cu. yd. of wet sludge, yielded 14 cu. ft. of gas per lb. of volatile solids added, no sludge has accumulated, the supernatant liquor is slightly alkaline, is not putrid, contains about 0.3% solids and has a 5-day BOD of 1,000 to 1,200 ppm.[C3-1, 2 & 3]



From Sewage Works Journal

Air bubbles from diffuser plate photographed against a background of cross-section paper for measuring.

Bibliography of Recent Sewerage Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C 4 *Sewage Works Journal*
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1. Digestion of Garbage with Sewage Sludge. By D. E. Bloodgood, pp. 3-12.
2. Experiments on the Digestion of Garbage and Sewage Solids. By F. H. Whitley, Jr., pp. 13-15.
3. The Dosing of Sewage Tanks with Ground Garbage. By H. E. Babbitt, pp. 16-21.
4. Diffuser Plate Studies. By A. J. Beck, pp. 22-37.
8. The Palo Alto Sewage Treatment Plant. By H. O. Banks, pp. 68-80.
10. Minneapolis-St. Paul Sewage Disposal Project. By G. J. Schroepfer, pp. 85-93.

D 4 *Surveyor*
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1. *c.* Difficulties Due to Presence of Water in Sewerage Workings. By H. C. H. Shenton, pp. 295-298.

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2. Sewage Chlorination, pp. 321-322.
3. Investigation on Rainfall Intensities. By E. O. Baxter, pp. 325-326.
4. The One-Pipe System of House Drainage. By J. S. Jones, p. 330B.

February 28
5. Some Experiments on the Oxygen Demand of an Activated Sludge. By H. H. Goldthorpe, pp. 351-353.
6. *c.* Outfall Sewer Construction at Colchester. B. F. R. O'N. Smyth, p. 359.

E *Engineering News-Record*
March 19
3. Health Board Recommendations for Sewers and Treatment Plants, pp. 414-415.

G 4 *Water Works & Sewerage*
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1. Review of Sewage Disposal in the United States at the Close of 1935. By S. A. Greeley, pp. 31-36.

March
3. *p.* Economics of Various Methods of Sludge Disposal. By A. J. Fischer, pp. 69-77.
4. Gas Explosion Damages Bristol, R. I., Sewage Works, pp. 91-92.
5. Things to Consider in Selecting Sewage Pumps. By V. J. Mill, pp. 93-94.

H 4 *Municipal Sanitation*
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1. Field Tests Show Feasibility of Home Disposal of Wastes. By M. M. Cohn, pp. 80-85.
2. Bristol, R. I., Attractive Treatment Plant. By R. S. Holmgren and H. K. Barrows, pp. 87-88, 108.

J 4 *American City*
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1. Automatic Sewage Treatment Plant at Atlantic City, p. 83.

L 4 *Civil Engineering*
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1. Multiple Stage Sludge Digestion. By A. M. Lawn, A. P. Banta and R. Pomeroy, pp. 172-175.
2. Aeration Tanks for Activated Sludge Plants. By S. W. Fruse, pp. 175-177.
3. Disposal of Garbage with Sewage. By C. E. Keefer, pp. 178-180.

P 4 *Public Works*
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1. Garbage Disposal into Sewers. By G. E. Griffin, pp. 12, 13.
2. Brookfield Sewage Treatment Plant. By W. B. Rollins, p. 15.
3. New Jersey's New Sprinkling Filter Requirements, p. 18.
4. Sewage Disposal for Homes, Schools and Institutions, pp. 28, 30.

T 4 *Technique Sanitaire et Municipale*
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1. Necessite d'une reglementation pour l'etablissement des reseaux d'egouts. By M. F. Nave, pp. 6-11.
2. Report of Commission des pentes des canalisations d'egouts, pp. 12-14.

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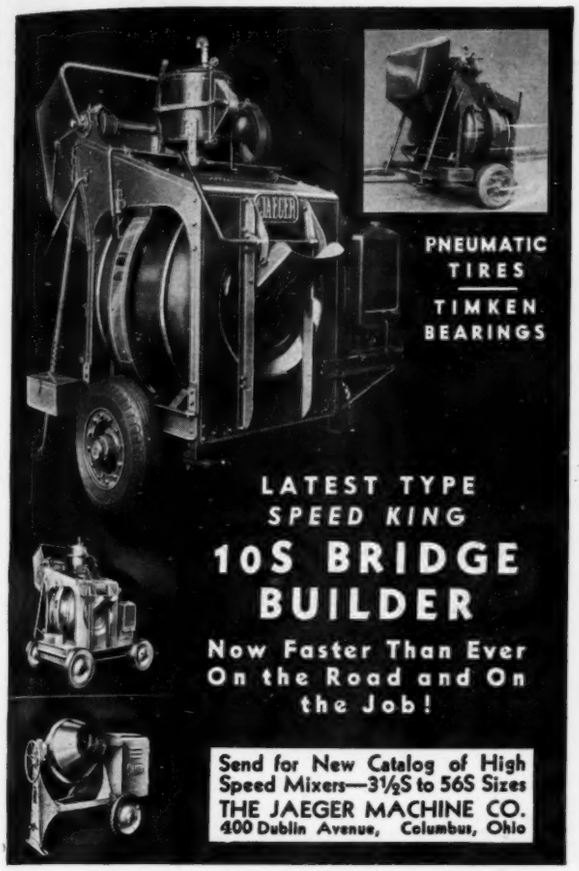
Year 1935-1936
1. Proposed Changes in Standard Methods for Examination of Water and Sewerage, pp. 123-129.
2. Bathing Places. Committee Report, pp. 209-220.
3. Limiting Standards of Pollution of Waterways. Report and discussion, pp. 233-240.



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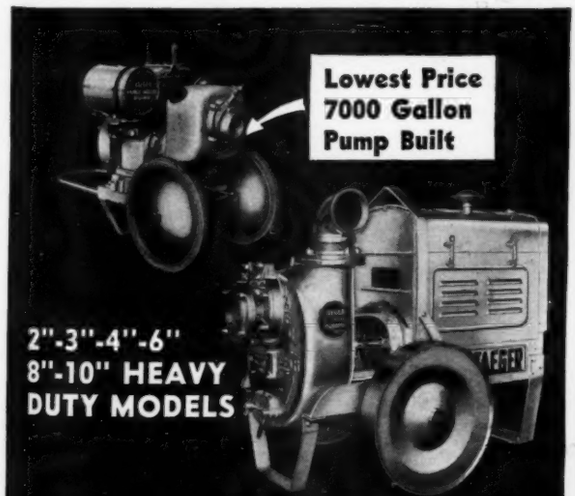

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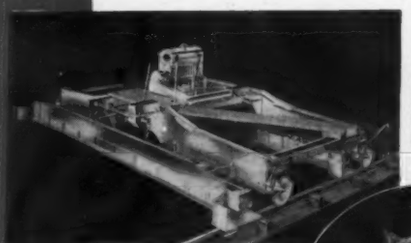

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Mixes in One Pass—Better than 10 Bladings

Operating Engines with Sludge Gas

ENGINES using sludge gas are now in service in a considerable number of sewage plants, nine of them being over 100 hp. These are: Ann Arbor, Mich., 120 hp; Springfield, Ill., 157 and 180 hp; Los Angeles Co., Calif., 200 hp; Charlotte, N. C., 225 hp; Cedar Rapids, Ia., 230 hp; Madison, Wis., 230 hp; Coney Island, N. Y., 300 hp; Peoria, Ill., 300 and 550 hp; Dist. of Columbia, 1,200 hp. Charlotte's were installed in 1928; those in Springfield in 1932 and 1934; all the others in 1935. The power is used for driving a generator in Cedar Rapids, Peoria, Coney Island and Dist. of Columbia, a blower in Springfield, Madison, Ann Arbor and Peoria, and a pump in Los Angeles.

The Los Angeles plant was described by the chief operator of the County Sanitation Districts, C. F. Tennant, another at Palo Alto, Calif., by Harvey O. Bank, formerly chief plant operator, and the use of such engines was discussed generally by Samuel A. Greeley and C. R. Velzy, at a meeting of the California Sewage Works Association. An abstract of the more important points made by the speakers is given below.

According to Greeley and Velzy, "With normal sewage there has not been any evidence of corrosion of engine parts by hydrogen sulphide." At the Los Angeles plant the gas is never found to contain hydrogen sulphide in excess of 0.02% and no scrubbing or other means of purifying the gas is provided there, or at Palo Alto. At Los Angeles the digester gas has a calorific value of about 650 btu and the consumption by the engine is 24 cu. ft. per hp hour when operating at 550 rpm under full load and best efficiency; at lower speeds the consumption may reach 33 cu. ft. At Palo Alto the consumption (by a remodeled gasoline engine) was 51.4 cu. ft. per kwh (38 cu. ft. per hp hour).

At Los Angeles "The quality of the digester gas compares favorably with other gases which have been used successfully in power generation. When compared with the low-grade group such as blast furnace, coke oven, etc., that have approximately 100 Btu per cu. ft. and which permit a compression of 200 lbs. or more and a gas-air ratio of 1 to 1, digester gas appears high in grade. When contrasted with rich natural gas with a Btu value of 1200 and a gas-air ratio of 12 to 1, digester gas value suffers somewhat. It is, however, well above the poorest, about half as good as the best, occupying about the center of the scale in value."

Oil drained from the crank case "shows a slow tendency toward acidification" which is probably due to the hydrogen sulphide in the gas, but apparently some 2000 hours or three months of operation can be obtained between crank case drainings when using the high-grade motor oil recommended by the manufacturers of the engine (a Clark gas engine) and known as "Triton S. A. E. 30."

Concerning actual operation of such an engine, Tennant said: "Sludge gas has a narrow firing range and the gas-air ratio must be nearly correct before combustion will occur; therefore it is essential that the starting unit have sufficient capacity to keep the engine in motion long enough for the operator to discover the firing range of the gas available at the time of starting"; and if the gas quality varies during operation, the gas-air ratio should be changed correspondingly.

The Los Angeles engine is used to supply power for pumping the plant effluent through four miles of 36" concrete pipe at 15 to 25 lb. pressure. The Palo Alto engine generates electricity for operating the pumps and other plant equipment, heating office and laboratory and neighboring airport buildings, and may be used in gas beacons for lighting the airport and landing field.

Greeley and Velzy say: "For generator drives, the engine generator unit operates considerably below full load most of the time and operates at constant speed. This simplifies the installation in some respects, but results in poor fuel economy at partial load, due to the low mean effective pressure. In driving a centrifugal pump, there is likely to be less variation in load, and the installation can be designed so that it will operate near the full load of the engine. This is usually a constant-speed unit or very nearly so, and in that respect is relatively simple. In the direct drive of air compressors, the possibility of varying the speed offers opportunity of fuel economy but introduces difficulties with critical speeds. Such a design provides a unit of great flexibility which can be regulated to the amount of air required by variations in the quantity and characteristics of the sewage treated. It is a characteristic of positive displacement blowers which are usually used on such units that the horsepower is directly proportional to the speed and so to the amount of air delivered. To the engine, this means that it will always operate at the mean effective pressure designed for full load. This results in fuel economy and high efficiency for all conditions. The speed variation, however, involves a problem of initial speeds which must receive very careful consideration by the designer."

The cost of the 200 hp Clark engine at the Los Angeles plant was about $7,000 installed, those furnishing the engine contracting to maintain it for five years, except for spark plug and magneto replacements, at 0.03 cent per hp hr. developed. Operation costs other than this have been 0.01 cent for oil and 0.0733 cent for attendance and spark plugs per hp hr. A rate of 15% is assumed for interest and depreciation. A motor in place of the engine would have cost $2,700, but Mr. Tennant calculates that there is a saving of nearly $460 a month by using the free gas instead of buying electricity.

Toledo Water Works Supports Other Division During Depression

The efficiency of the water works department in Toledo, Ohio, has been an important factor in contributing to the support of other city departments in the past five years. Previous to 1934, when its funds were segregated, the Toledo water works department had paid $790,000 to the city for the operation of other departments. At present it has $235,000 cash on hand, which will be increased by $335,000 when repayment of funds advanced to the city at the beginning of 1936 is made.

In addition to the profitable operation of the department, Toledo water has for years maintained one of the highest purity ratings in the state.

Spraying and Burning Vegetation Along California State Highway Roadsides

By W. A. Smith
Assistant Maintenance Engineer

CALIFORNIA, in common with other western states having an arid summer season, has a special problem in the reduction of fire hazards to property and watershed cover along her roadsides.

The spraying and burning of roadside vegetation for the 1936 season is now under way. This work, which involves protective measures along 1,100 miles of State highways at an annual expense of some $80,000, has been a regular part of the division of Highways maintenance program since 1929. Prior to that time, control measures were undertaken only at locations where owners of adjoining property or local organizations cooperated in the work.

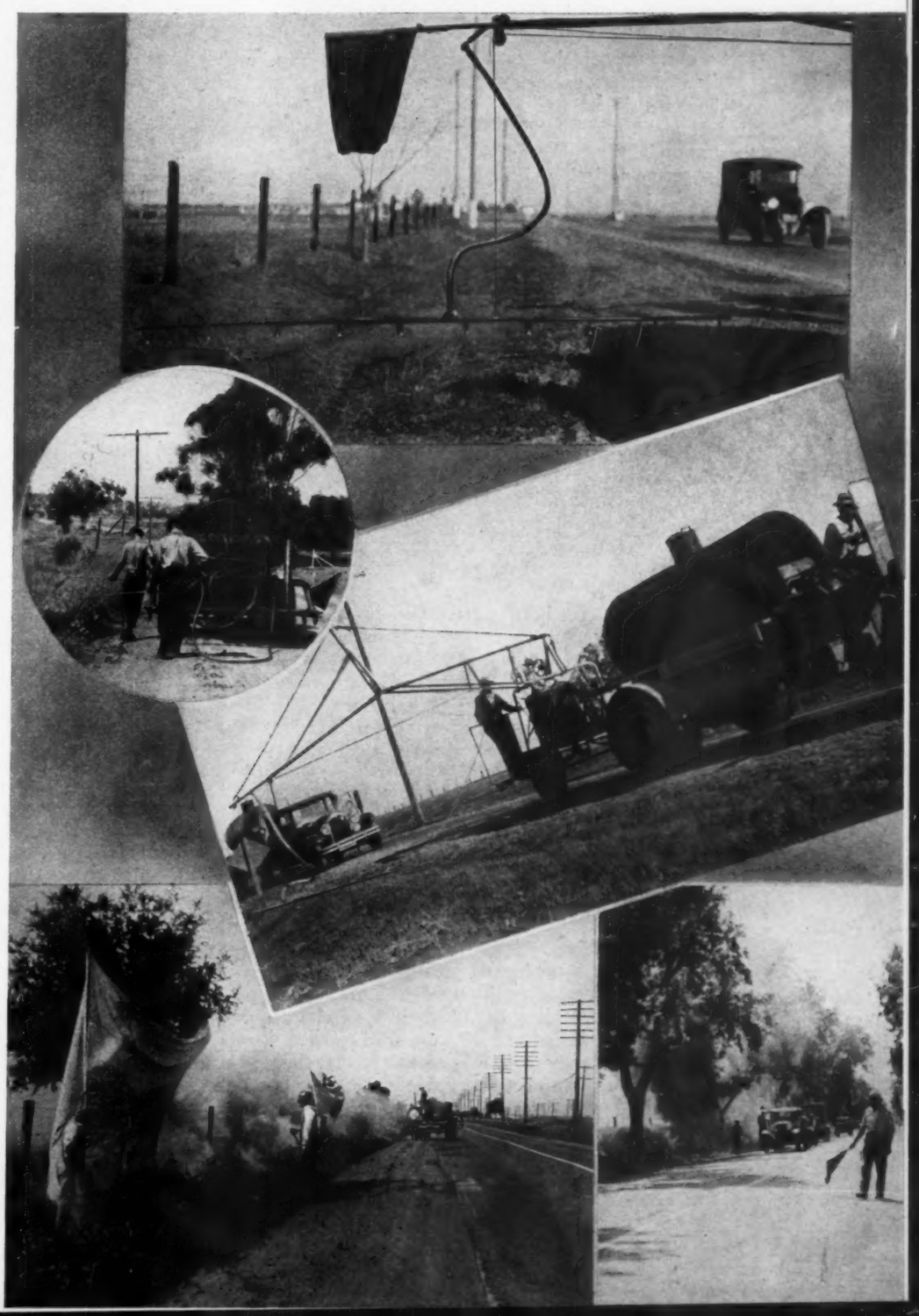
The purpose of this roadside spraying and burning is to provide a firebreak between the highway and adjoining property. Its justification lies in the protection afforded the property owner or public interests against the increased hazard due to volume of motor traffic which improved highways bring, as well as in prevention of erosion damage to highways at locations where natural cover may be destroyed by fire, and also in the fact that insurance rates on grain lands are thereby kept to a lower level.

The program has been planned on the basis of maximum results in fire reduction for the amount expended, rather than attempting 100 per cent clearing as advocated in some sections.

Where to Spray

In general, no spraying is done opposite locations where a natural or artificial firebreak already exists, either adjacent to or within a reasonable distance of the right of way. It is considered that the clearing of vegetation from locations adjacent to orchards, vineyards, plowed land, railroad rights of way, or streams which parallel the highway is not justified, as reasonable protection already exists.

Likewise, bare cut slopes five feet or more in height present a natural obstruction against fires being started by passing traffic.



Spring cleaning starts in winter on State Highway roadsides and the annual spraying and burning operations are under way along an 1100 mile front. At top, a 10-foot spray bar of a Diesel oil spraying unit. Center, a weed spraying outrigger on oil spreader trailer. Inset shows hand-spraying method. At bottom, burning operations with protection for trees and motorists. Courtesy California Highways and Public Works.

Spraying and burning can only be carried on, to advantage, over grassy areas. Where brush abounds, clearing is the only effective measure and, when that is done at considerable expense, the area is exposed to the growth of grass and a more hazardous condition is thus created.

Methods and Materials

The spray material adopted and methods followed, as well as the equipment used in making the application, were developed as the result of considerable experiment. Likewise, problems have arisen in the matter of burning the sprayed areas which required standardization.

Under conditions encountered in California, where the vegetation drys up rapidly with the coming of the first hot days of the season, it is necessary to spray a strip to either kill or dry out the grass sufficiently so that it may be burned while adjacent areas are still too green to present a hazard. This strip is ordinarily 9 feet in width, immediately adjacent to the fence lines and was adopted as being the maximum which can be handled by means of the spray bar equipment.

The location adjacent the fence lines includes the area of heaviest vegetation and also permits burning of the section between the shoulder and sprayed area later, if that seems desirable.

It must be borne in mind that efforts are directed simply to creating a firebreak. It is not desired to sterilize the soil, since at many locations it may not be necessary to spray another season. On account of the appearance, there are many individuals and some organizations who roundly criticize the work.

For most effective and economical results, the spray material should be applied when the vegetation is about two inches high. At that time the area can be uniformly covered; the growth is tender and practically a perfect kill is assured. There is the further advantage at this stage that no burning is required, although it may be necessary later to go over certain low areas where moisture starts a new growth.

Due to the rapid growth and uncertainty as to weather, careful planning is necessary and it is possible, at best, to cover only a portion of the areas at the ideal time.

Experiments have been carried on—in one case extending over several years—to determine the most effective nonpoisonous material. Various proprietary chemicals were included in these tests. Nothing was discovered, however, that was more effective or as economical as Diesel oil having the following specifications to insure a uniform material of adequate toxic effect:

Specific gravity (A. P. I.) at 60° F .....
.....not less than 27° Be
Flash point (Penskey-Martin closed cup).....
.....not less than 150° F
Viscosity (Saybolt Universal) 100°F.....
.....not more than 50 seconds
Distillation—90% point .....not over 680°F
Water and sediment .....not more than a trace

The Diesel oil is applied at the average rate of one-tenth gallon per square yard of area to be treated by means of tank truck outfit equipped with pressure pump and spray bar. The spray bar is fitted with orchard type spray nozzles designed to give a uniform spread.

To insure such a spread, it is necessary that the position of the spray bar be adjustable so that it may be readily raised or lowered and reach out to varying distances from the roadway. Various designs have been used to serve the purpose. The pictures herewith illustrate the general idea.

Workers Held Responsible

After the oil is applied, it is allowed to penetrate and act on the vegetation, which gradually turns brown. Burning operations, if required, are then started.

Under existing legal restrictions, any damage which results through negligence of an individual in the State service is a direct responsibility of that individual. Special care is taken, therefore, to see that adjoining property, fence posts, trees, etc., are properly safeguarded, as well as provision made for the protection of traffic. Knapsack type pumps or fire trucks are provided for each crew, and flagmen warn and direct traffic.

Costs and Results

The cost of spraying averages from $50 to $60 per road mile of two 9-foot strips, and burning operations cost about $20 per road mile, or a total of $75 to $80.

In addition to the areas where spraying is necessary, a considerable mileage is also protected during the regular maintenance operations by blading, disking, or mowing. Protection by this means is considerably cheaper in first cost, averaging about $6 per road mile for a reasonable width.

Any grading operation, however, has the disadvantage of disturbing the road section and loosening the soil to wind and water erosion so that the ultimate cost, considering damage done and discomfort due to dust nuisance, may well exceed the cost under the spraying method. There are many locations, also, where it is not possible to work equipment, and such areas must be sprayed.

There is no question as to the beneficial results of this work. Prior to the initiation of this protective measure, a number of serious fires could be anticipated each season. Last year not a single fire of any magnitude was reported as having started along any highway in this state—a real proof of effectiveness.

This article is published through the courtesy of California Highways and Public Works.

Nation-Wide Census of Construction Begun by Census Bureau

A nation-wide census of the construction industry is being made by the Census Bureau, beginning January 2nd. The data collected will apply to the year 1935. Every effort will be made to complete the field canvass in three months and to issue the first report by July of this year.

Trained field men of the Bureau will make personal calls upon contracting establishments, explain the report forms and assist the contractors to fill them in. Only sworn employees of the Bureau are permitted to examine the reports, and then only for the purpose of compiling statistics, and no information will be disclosed which would reveal any of the facts or figures of individual reports.

The aim has been to limit the questions to those that are of fundamental importance, a number of the leaders of the construction industry having aided in preparing them. Among the figures obtained will be those of the number of persons employed by contractors, manhours of work in 1935, disbursements for salaries and wages, value of construction work performed and expenditures for materials. The work performed will be classified under five types, also whether new construction or remodeling, repairs or maintenance, and public or private.

Headquarters will be in Philadelphia, with Fred A. Gosnell, chief statistician, in charge.

Roll-A-Plane

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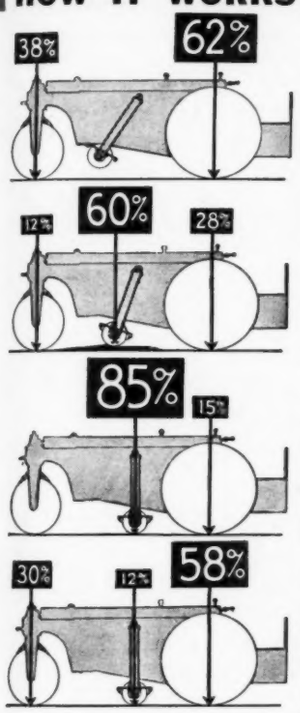
HOW IT WORKS



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Here are the reasons: As shown above, the machine first goes on the job as a conventional roller to get compaction. Then the center roller is immediately dropped into position and the wavy surface developed by the usual rolling action is ironed out.

While the binder is still in a plastic condition, the center roller finds the high spots and by a tremendous spot pressure, it forces the excess of material into the nearby voids. The high spots are removed; the material relocated where it is most needed—and because the binder has not had time to harden it will reseal to form a close bond of even density.

This closer compaction and the even surface of the finished job, are all accomplished at a saving of from 30% to 50% of the time formerly required, since all cross rolling is eliminated.

More and more states are writing specifications which call for closer tolerances on asphalt highways. Write for your copy of "The Roll-A-Plane Process." It explains the use of these machines from base course to wearing surface. Your name and address will bring it to you without cost or obligation.

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Sewage Gas Explosion at Bristol, R. I.

ON THE night of February 13th of this year, an explosion occurred in the control building of the new sewage treatment plant at Bristol, R. I., resulting in damage to the roof, which was moved several feet in an easterly direction, and to the glass doors, windows and partition between the laboratory and the chlorinating room. The cost of repairing the damage is estimated at about $1,000. No persons were injured, as fortunately no one was present at the time.

The Bristol plant, which was placed in operation in July, 1935, contains mechanically cleaned bar screens, two rectangular sedimentation tanks equipped with sludge-removing mechanism, sludge pump, chlorinator, a circular sludge digestion tank with floating cover, and gas utilization apparatus for heating the digester and the control building.

As no one was present at the time of the explosion, the cause and manner of it can be judged from the results only. As the general effect was that of a gas explosion, and there was no explosive material other than digestion gas known to be present in the plant, this is believed to have been the cause. How this came to cause the explosion is a subject interesting to all designers and operators of such plants, and it is important therefore to know the general design and especially that of the gas utilization equipment.

The ground floor contains, in separate rooms, the chlorinator equipment, bar screen, lavatory and small laboratory, the last containing various temperature-recording instruments. A stairway on the west side connects this floor with a basement about 16 feet below, in which are the sludge pump, boiler, work bench and gas and heating equipment.

Gas is piped from the digester under a constant pressure of about 6 inches due to the weight of the floating cover. After entering the basement it flows through a water seal condensate pot trapped to give a 9½" seal, the main gas meter, an adjustable water seal relief pot, waste gas meter and out to a waste gas burner located about 60 feet from the building. The hot water boiler is of the coal fired type, and coal was being used for fuel at the time of the explosion. The gas meters are equipped with a valved by-pass, so that, by cutting out the meters, the gas can flow directly to the relief line leading to the waste gas burners. Should the valves on both the meter lines and by-pass line be closed at the same time, however, the gas could not reach the waste gas line. Also, should this line be stopped in some way it would of course fail to function.

It seems that this line must have failed to function, either because of the closing of the valves or because of an accumulation in it of condensate in a liquid or frozen state (the outdoor temperature was well below freezing), or both. This would result in an increase of gas pressure, and apparently this occurred and caused the forcing of the 9½ inch overflow seal of either the condensate or the relief trap, or both. These overflow seals drain into a sump in the basement floor and also vent directly into the main floor of the building, and with the trap seals forced, gas could escape into either the basement or the main floor rooms. Presumably gas so escaping (that in the basement rising up the open stair well) accumulated under the ceiling of the ground floor, the windows and doors being tightly closed, until it was "touched off," probably by the fire under the boiler.

The record on the thermometer chart shows a ragged line at a little before midnight, indicating that an explosion may have occurred then. It is of record, also, that about 2 A.M. the telephone receiver was detached from the hook, causing the night watchman at a nearby boat yard to think something was wrong at the plant. This might indicate that actually two explosions occurred.

Whatever the exact cause or happening, it seems practically certain that gas accumulated in the building—something which should be made impossible by the design of the gas utilization equipment. The piping and general layout of this equipment was, we understand, after a design prepared by the contractor and would seem to be open to criticism. The vents from the overflow seals should be carried to the atmosphere well above the roof, and the seals themselves should not terminate in an open pipe in the building. It should be impossible to close both the pipe through the meter and the by-pass around it at the same time; a two-way valve would be one way of effecting this. And it should be impossible for condensate to collect in the waste gas line.

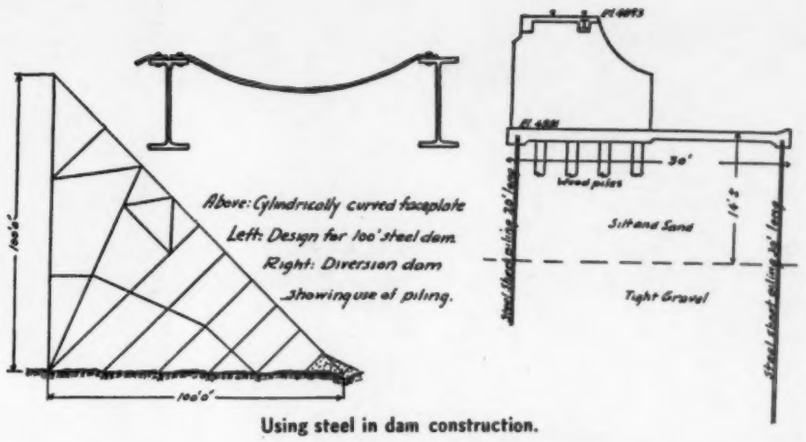
The fire and explosion were confined to the control building—the digester does not seem to have been affected in any way. This would seem to indicate the advantage of providing means for positive and constant gas pressure in digestion tanks; the simplest means for securing which probably is the use of a floating cover, for which it is claimed that it reduces the possibility of gas explosion in the digester.

It certainly is to be hoped that this accident will not act as a deterrent to the utilization of sewage gas, which is no more dangerous than the use of a gas range in a dwelling—they explode when unwisely used. But it should cause those responsible for installing such plants to make sure that the entire gas installation is designed by some one technically qualified to do so, and built carefully according to the design.

Moving 5,000 Cubic Yards Per Day on a Highway Contract

In the construction of the Alemany link with San Francisco's boulevard system, involving 244,000 cubic yards of roadway excavation and about 2 million station yards of overhaul, tractors and carryalls were used. The excavation was chiefly sand. Three 80 h.p. tractors, with three 12-cu. yd. carryalls, operating on three 6-hour shifts, moved 5,000 cubic yards per day. The roadbed was graded 56 feet wide and surfaced with a bituminous treated crushed gravel or stone surface, 42 feet wide and 3 inches thick, laid on a crusher run base 6 inches thick.

The Use of Steel in Dams



Using steel in dam construction.

IN STEEL dams, the first essential element is a watertight steel face, which may be supported by steel frames, trusses or arches. Or rock or earth fill dams may be faced with steel plates to secure watertightness. Steel is also used for corewalls and, in the form of sheet piling for cutoff walls. All these uses are described in a recent publication of the American Institute of Steel Construction, written by Otis E. Hovey.

Dams wholly of steel most often consist of supporting frames of triangular shape, with the inclined side directly supporting the face plates. Diagonal struts or braces, normal to the inclined face, carry the load directly to the foundations. Toward the crest of the dam, it usually becomes necessary to use one or more struts which are not normal to the face in order to limit the bottom width of the frame. The face plates will usually be cylindrically-curved, with the concave side toward the water. Flat plates are suitable for use when only supported by and built into masonry. A cylindrically-curved face plate is practically a suspension system in which stresses can be calculated easily.

The mathematics of design are given in detail for the design in the publication mentioned, and the illustrations herewith are from it. Design for a steel dam 100 feet high is shown.

We believe there has been no recent construction of this type, but such dams built 30 or more years ago are still giving good service. Descriptions of several of these dams and reports on present condition are given in the text.

Fill Dams With Steel Cores

When steel plates are used for cores in rock, gravel, or earth-fill dams, general principles are the same as when a concrete or other impervious membrane is used. The steel diaphragm is extended into concrete filled trenches, or welded to steel sheet piling, thus giving a continuous watertight cutoff. Construction can proceed handily as the fill progresses, and such walls are flexible, permitting considerable settlement or movements without rupturing the plates. Expansion joints should be provided. The best place for the corewall is near the upstream face. When steel is used, the plates should be coated with a protective covering to prevent corrosion.

Fill Dams With Steel Face Plates

When the plates are used at the upstream face, it is necessary to prepare the face of the fill very carefully. General principles of dam construction must, of course, be observed. This construction merely gives the advantage of having the cut-off structure in the most convenient location for inspection and maintenance.

The El Vado dam in New Mexico, which is of this type, was begun in 1933 and completed in 1935. It is 170 feet high and 1,200 feet long; composed of gravel fill, the upstream face slopes 1½ to 1, and the downstream face 2:1. The upstream face is covered with ¼-inch thick steel plates 8 feet 4 inches by 24 feet 5 inches in size placed directly on the gravel fill. These plates are spliced on the horizontal seams by lapping and welding. Bent plate expansion joints are spaced 25 feet apart, welded to the face plates. At the crest of the dam, specially formed crest plates were used. Great care was used throughout to obtain watertightness, particularly at the heel wall and abutments.

The plates were not painted on the side in contact with the fill, but the exposed surface was quite carefully protected.

Steel Sheet Piling Cut-Offs

The use of steel sheet piling in preventing flow underneath a dam is not uncommon. This increases the resistance to the flow of water through underground channels and is particularly effective where corewalls cannot be carried down to rock or other impervious strata. The best location is near the upstream heel of a masonry dam; and for an earth or fill dam between that point and the middle. In the latter case, the cut-off piling must be tied to the corewall with a tight joint.

E. W. Lane believes that a vertical surface, such as is presented by sheet piling, is much more effective in preventing underground flow than a horizontal surface, such as presented by the base of a dam, and this theory is quite largely used by the U. S. Bureau of Reclamation.

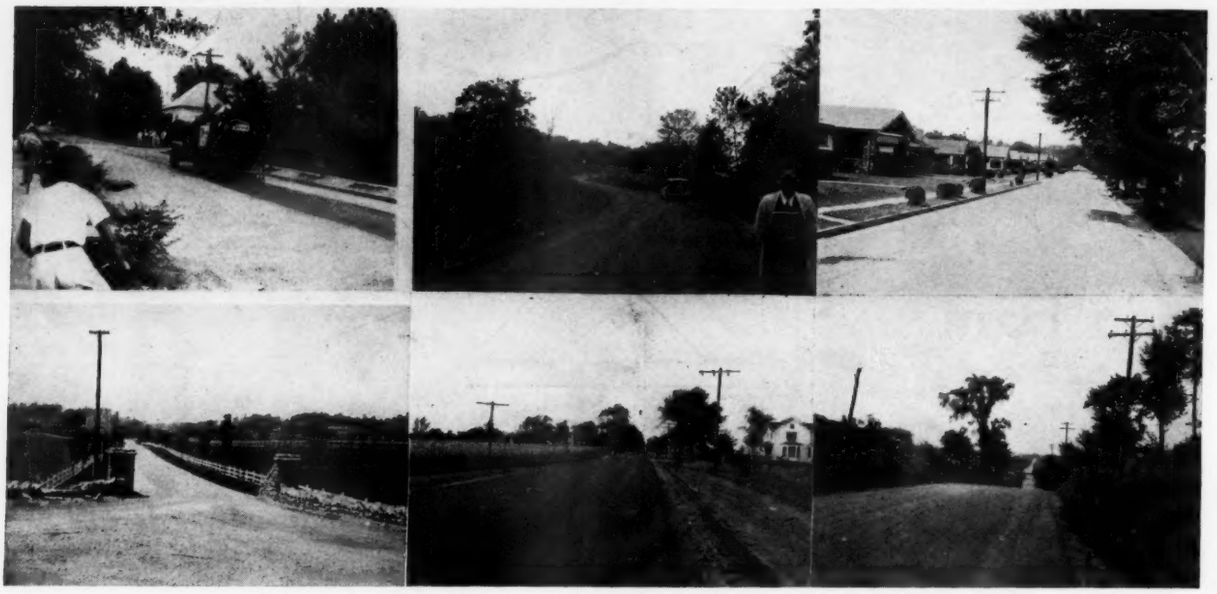
The Fort Peck dam, now under construction in Montana, which will bar the flow of the Missouri River, will have the deepest steel sheet piling cut-off wall yet built. The dam will be of earth, about 255 feet high and 2,875 feet thick at the base. Some of the piling will be driven to depths of 150 feet.

The complete text by Mr. Hovey contains 114 pages, including a rather complete bibliography and a number of illustrations.

Construction Equipment Used by CCC

The following items and quantities of heavy equipment purchased give an insight as to the type and magnitude of the work of the CCC.

Tractors, 1,733; dump trucks, 8,533; pickup trucks, 2,994; ambulances, 520; tractor trail builders, 1,145; fine graders, 1,247; compressors, 837; jack air hammers, 1,066; power shovels and draglines, 135; concrete mixers, 303; bulldozers, 55; rock plows, 551; generators, 15; well drilling rigs, 5; road rippers, 220; slip scrapers, 981; rock crushers, 36; garage repair outfits, 110; trailers, 16; hoists, 118.



Top, left, applying Seal Coat in Birmingham, Ala.; center, a gravel tar mat treatment in Wayne Co., Mo.; right, more work in Birmingham. Lower, left, tar retread in Giles Co., Tenn.; center, gravel treated with tar, Wisconsin; and right, a gravel turnover treatment in Wisconsin.

Tar Seals and Stabilized Bases Permit Better Road Construction

By C. H. Olmstead

Consulting Engineer, General Tarvia Dept., the Barrett Co.

THERE are two developments which, if properly used, permit greatly improved low-cost roads and make it possible for these types to care for heavier traffic burdens. These are the stabilizing of bases, and the addition of proper and adequate seal coats.

Base and subgrade stabilization are being given extensive technical study and the results obtained to date with surface treatments on stabilized bases are very gratifying. These stabilized bases are very dense and their resistance to frost action appears to be great. As most failures on low-cost roads are due to base failures, stabilized bases may be expected greatly to reduce trouble from this source.

A tar-primed base is, in a measure, a stabilized base to the depth of penetration of the tar prime. In order to make this depth as great as possible, the lighter grades of tar should be used. However, most state highway specifications call for definite quantities of tar prime, from ¼ to 1/3 gallon per square yard. This limitation in quantity has forced the use of heavier grades of tar prime in order to seal a porous base and also to keep the surface treatment material from penetrating the base, which frequently takes place when an insufficient amount of a light tar prime is used. Better results and a greater stabilization of the base will be accomplished by using a light grade of tar prime in sufficient quantities thoroughly to fill all the pores of the base as deeply as it will penetrate; and to seal the surface of the base so that the surface treatment material will remain on the surface of the base and properly hold the seal cover.

Surface Treatment

Tar surface treatments consist of an application of about ⅓ gallon per square yard of heavy surface treatment tar to a tar-primed base for either original treatments, or for a resurfacing on an old bituminous surface. This application is covered with crushed aggregate or pea gravel, uniformly distributed and lightly rolled. The cover material may be lightly dragged as a method of uniform spreading. Many engineers appear to interpret the dragging requirement to mean mixing. The mixing of the single surface treatment and seal cover uses up considerable tar in coating the entire surface area of the cover material, thus reducing the amount of tar available for waterproofing the surface and leaving an insufficient amount of tar for the embedding of the chip. For good surface treatment work, there should be a substantial thickness of tar on the base to insure the cover material being well embedded and held in place.

This light type of treatment, when used as an original treatment on a primed base, should be given a seal coat the following year. This seal coat will result in much lower maintenance costs for the next few years than if the surface were maintained only by patching and will produce a surface of much more pleasing appearance and smoother riding qualities.

On light surface treatments, excess cover material should be removed from the surface, after compaction by traffic is accomplished, on account of its high abrasive action under traffic.

Double Surface Treatment

Many engineers prefer to use the double surface treatment for either original surface treatment or resurfacing, using a larger aggregate for the cover of the first application and a finer cover for the seal coat. This method of construction provides the desired seal coat immediately and permits the use of a larger sized

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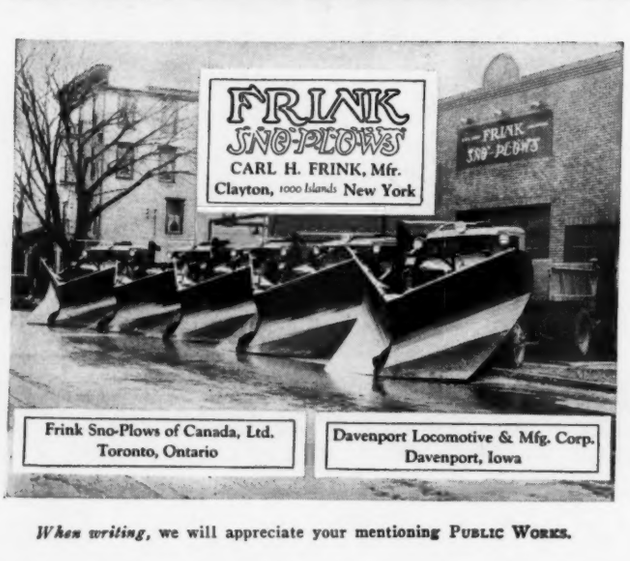

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aggregate for the cover of the first application, giving considerably more stability to the thicker surface, and requiring less maintenance during the early period of its use. As with the single surface treatment, the seal cover should not be mixed but can be lightly dragged.

Tar-Gravel Mulch or Turnover

Where local gravel is available, tar-gravel mulches are coming into extensive use. The gravel surface usually contains a large amount of fine aggregate. Satisfactory surfaces have been constructed using as much as 70% passing a ¼-inch sieve and with all the aggregate passing a 1-inch screen. The loose material on the road is incorporated in the mix and usually contains considerable dust. Owing to the variability in gradation and quantity of the aggregate spread per square yard, it is good practice, before the final smoothing out and rolling, to study the mix and apply light quantities of tar over those sections that appear deficient in tar binder. The aggregate and tar is then given another mixing. From 1 to 1.3 gallons of retread tar is required to bind the aggregate for a 2-inch compacted thickness of surface.

If the seal coat is not to be applied immediately, but deferred until the following construction season, the surface should be given a light application of the same grade of tar as used in the mix, from 0.10 to 0.15 gallon per square yard, as a so-called "fog-coat." No cover is used on this application. This light application of tar penetrates to a small degree into the mix, seals the surface and provides additional binder to hold the top aggregate together under the severe stresses imposed by present day traffic with its high speed, low pressure, and wide grip tires.

A tar-gravel mulch surface should be sealed shortly after its completion or in the following construction season, using the material and methods described for single surface treatments.

Tar Retread or Mixed-in-Place Surfaces

Tar retread surfaces are frequently rather open unless well keyed with chips during rolling and having sufficient plastic tar in the mix to hold the key stone. Approximately 9/10 gallon of retread tar or surface treatment is sufficient to bind a compacted thickness of two inches. Hot surface treatment tars are rapidly coming into use as binders and seal coats for retread type pavements for application during the summer months. Too large sized key stones, if hard, tend to wedge the top layer of aggregate apart and not fill the surface interstices. If a soft stone chip is used, a larger sized chip will be acceptable.

Seal Coats

Retread surfaces should be sealed during construction as a necessary part of this type of pavement. When the retread surface has not been properly choked with key stone, a large amount of the seal when applied will penetrate into the mix, frequently softening the pavement and leaving an insufficient amount of tar on the surface to hold properly the seal cover.

Better results and a more serviceable surface can be obtained by using a double seal coat. A first application of ¼ gallon of tar per square yard is given, and the surface is covered with the usual chips. This application may be mixed as a leveling course to take out small irregularities and to insure that all the surface voids are well filled. The surface is then rolled. A final seal coat of ¼ gallon of tar is then applied and lightly covered with a finer chip. The final cover may be lightly dragged to secure a uniform distribution but should not be mixed. Only sufficient chips should be used to

cover uniformly this application and prevent the tar seal from being disturbed by traffic. The final cover may be lightly rolled.

In the late fall a retread tar is more satisfactory for sealing than a hot surface treatment tar. The retread tar is slower setting but in cool weather will hold the seal cover. The heavy surface treatment tar in cold weather will set up quickly on cooling and may not properly hold the cover chip which will be removed from the surface by traffic and washing. The following spring when the surface is warmed, the hot surface treatment tar seal may soften, bleed, and pick up under traffic unless given an immediate covering of chips. The stability of many otherwise good surfaces has been lowered by using fine sand or rock dust to blot up this bleeding, when the use of a fair sized chip would have produced an excellent and stable surface. Under conditions of spring bleeding a fair sized chip, uniformly spread over the bleeding surface and rolled, will remedy this condition which should not exist if the proper grades of tar, proper sized aggregates and good construction methods were used in the construction.

Tar seal applications should not be heated to too high temperature. Tars heated to high temperatures are very fluid and easily penetrate most retread surfaces, thus reducing the available tar for holding the seal cover.

Grades of Tar

The following grades of tar, with their consistencies and application temperatures for their various uses, are recommended:

Tarvia Grade	*Standard Grade*	*Application Temperature*	*Consistency Engler Specific Visc. 40°C*	*50°C*	*Float Test Seconds*
Regular "B"	TC-1	60°-100°F	8-13		
Medium "B"	TC-2	60°-125°F	13-18		
Heavy "B"	TC-3	80°-150°F	18-25		
Heavy "B"	TC-4	80°-150°F	25-35		
Regular Retread	TM-1	80°-150°F		16-22	
Heavy Retread	TM-2	80°-175°F		26-36	
Regular "A"	TH-1	175°-225°F			60-150*
Heavy "A"	TH-2	175°-250°F			150-210*
"XC"	TP-1	200°-250°F			100-160†
"X"	TP-2	200°-250°F			160-220†
Regular "KP"	TCP-1	60°-100°F	35-60		
Heavy "KP"	TCP-2	60°-100°F	60-80		

* At 32°C; † at 50°C.

TC-1, TC-2 and TC-3 are primes, the latter for open bases; TC-3 and TC-4 are suitable for cold surface treatment; TM-1 and TM-2 are suitable for seal coats, gravel mix and retread binder; TH-1 and TH-2 are for seal coats and retread binders; TP-1 for patch-binding and crack filling; TP-2 for patch binding and penetration macadam binder; TCP-1 and TCP-2 for patching binder, seal coat and resurfacing binder.

Another step forward in the development of low cost surfaces has been the standardization of aggregate sizes and uses, developed by the aggregate producers in cooperation with the bituminous interests. The acceptance of these aggregate gradations for their recommended uses will greatly improve and simplify low cost road construction.

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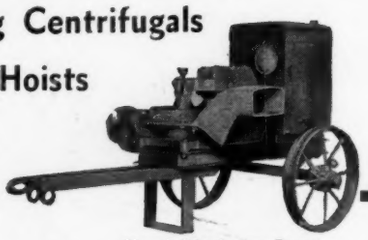

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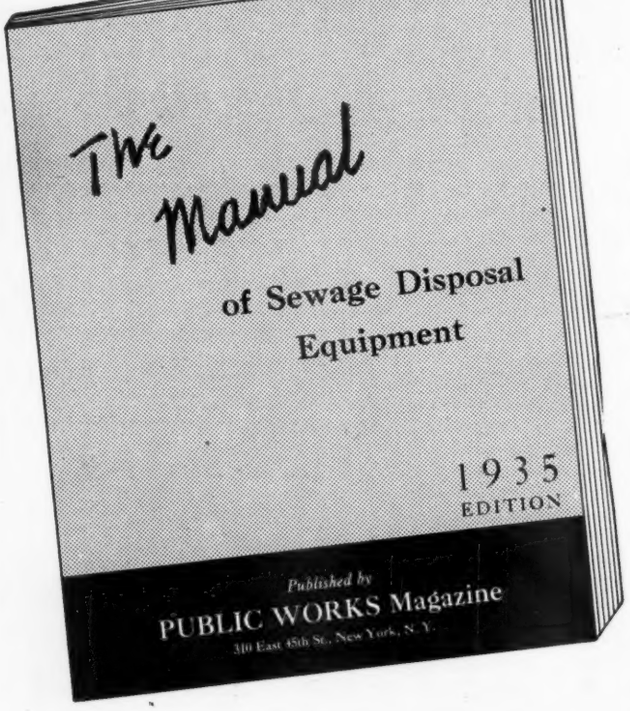

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9—Sewage and Sludge Pumps
10—Use of Chemicals
11—Construction Materials
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Cleaning Up and Repairing After Floods

MANY homes and many public buildings have been damaged by flood waters in the past few weeks; others will be damaged in the next few weeks when high waters may be expected over many areas.

The Bureau of Agricultural Engineering of the Department of Agriculture has issued a list of bulletins which will help in this work of rehabilitation. It has also issued a statement, which is published herewith because in many cases city technical officials will be called on for advice and help.

After the emergency sanitary precautions, which are public health matters, comes the problem of making the home habitable again. First of all, a flooded house must be dried out. Open windows and doors, and get the heating plant working to circulate air, to aid in drying. Most of the woodwork that has been under water will be swollen and warped. Probably it will be necessary to pry off the beading strip around the window frames to open them. Doors will have to be removed and later rehung. Before the heater is started it must be thoroughly cleaned of mud, especially inside. Use water, a wire scrubbing brush and a long stick to reach every part.

Every room touched by the flood will have to be emptied and cleaned thoroughly. Mud stains are hard to get off and after all the preliminary cleaning is done it may be necessary to paint or varnish the woodwork, and refinish the walls, but those jobs can come much later. Floor boards will be warped and buckled. In some cases the boards can be forced back and securely nailed. In others, the only remedy after the floor has dried out will be to lay new flooring over the old or cover it with linoleum over a heavy felt base.

The mud from a flood leaves a bad odor everywhere. This is particularly hard to get out of the basement even after the mud has been shovelled or washed out and the floor and walls washed down and scrubbed. Sprinkling floors and walls with chloride of lime will help deodorize and will also disinfect. This is very corrosive to metal and should be used with care. Acid phosphate counteracts ammonia odors but does not disinfect. Odors are unpleasant, but not necessarily harmful.

Stoves, like the furnace, will show rust and will need thorough cleaning. Go over every part carefully, particularly the flues, scouring with steel wool and crude oil, giving particular attention to the inside of the oven at the back and other spots hard to reach.

Water-soaked electric wiring may cause short circuits. It is dangerous to use it until it has been tested by an electrician. Electric equipment must be cleaned before use. Some motors may be reclaimd if sent to the factory. After other floods there have been committees set up in some communities to collect motors of washing machines and other electric equipment and arrange bulk shipments for reconditioning.

The work of reconditioning the furnishings of the house will take a long time. The preliminary step is to wash everything thoroughly and then determine what is worth salvaging. Some of the wood furniture can be scraped and refinished later. Veneered surfaces are almost impossible to repair in the home, and gluing requires special vises. If overstuffed furniture has been completely soaked, it may be necessary to remove all the stuffing and reupholster the piece. Slip covers will do to cover upholstery that is stained but otherwise in good condition.

Mattresses that have been water-soaked are usually impossible to recondition at home. If they cannot be sent to a renovating company they may have to be destroyed and replaced. Pillows can be washed in the usual household way. Mildew attacks the fibers of fabrics and mildew stains are almost impossible to take out. Therefore fabrics should be dried at once even if they cannot be washed immediately.

All household cottons and linens touched by flood waters will have to be washed, sunned, and treated to remove as much of the mud stains as possible. Hot water will set the stains, so stained articles must first be rinsed in cold water several times and then put into soapsuds. Some of the white articles will respond to repeated rinsing and sunning. Textile specialists of the Bureau of Home Economics warn against overbleaching flood stained fabrics. The usual laundry bleaches are of no avail in removing these

stains. Silk, rayon and woolen clothing and wool blankets will have to be carefully washed. The huge task of laundering everything in the house should not be increased by wasting time on articles that are so badly damaged as not to be worth reclaiming.

State health officials have already issued warnings about boiling drinking water and water used in cooking or for washing food utensils. Most of the food reached by the flood water will be unfit to eat, unless it can be washed and boiled, but canned goods that show no leak, swelling or other signs of spoilage may be washed thoroughly and used. The tops can be disinfected by inverting in a calcium chloride solution.

Dead animals should be disposed of immediately, by burning whenever possible, to prevent water and soil pollution, spread of disease, and increase of vermin. They should preferably be burned where they are. One way to burn a large animal is to dig a trench about a foot deep and the width of the carcass along its back, fill with dry wood, start the fire, and turn the body over on its legs. Hogs and smaller dead animals can be burned on old iron wheels used like grates. If burning is impracticable because of lack of fuel or for other reasons, bury the carcasses deeply in locations where seepage will not reach the water supply.

Mosquitoes are probably the most troublesome of the insect pests that thrive in inundated districts and stagnant pools. Tremendous broods of "Aedes vexans," or flood water mosquitoes often appear. The Bureau of Entomology and Plant Quarantine says these are bad biters and travel 5 to 10 miles from their breeding places. Mosquitoes can be kept down to some extent by the use of fuel oil or kerosene on water in swamps and pools, by emptying cans, pails, and rain barrels near the house, and by draining stagnant pools. Stable flies and blow flies breeding in undestroyed carcasses may become a nuisance and spread disease. Burn all trash, and spread manure thinly on land to be plowed. Where repairs are required to wooden buildings or in wood used in foundations consideration may well be given to following approved practices to prevent damages by termites or white ants.

A partial list of the bulletins mentioned by the Bureau will be found on page 66 of this issue. As stated there, these will be sent without cost so long as the supply lasts. As a rule, the Department of Agriculture is fairly prompt in forwarding these bulletins, but sometimes a message to your Congressman will produce quicker results.

One of the most common problems in cleaning up after floods, and one that is not mentioned in the above statement, is that of pumping out cellars. Flooded cellars are not only a serious inconvenience but are also a public health problem. Cold and damp houses promote influenza and pneumonia. Furnaces cannot be restarted with several feet of water around them; it takes a long time for the water to seep away. Pumping is necessary.

The ordinary trench pump is excellent for this work, but the average city does not have nearly enough of them to make any substantial progress if a considerable portion of the city has been flooded. Such pumps may often be rented from local or nearby equipment dealers; or it wouldn't hurt most cities to buy a few because they are a useful tool. In some localities the CCC authorities have come forward with equipment and personnel. Fire engines may be used, too.

The matter of public health has been touched on lightly in the first paragraph. The city water supply is ordinarily perfectly safe as soon as it becomes available. Of course, all wells that have been flooded must be cleaned out and chlorinated before the water from them can be used again.

Missouri Municipality Repeals Gasoline Tax

The city of Linn, Missouri, has announced the repeal of its one-cent per gallon local gasoline tax, which was paid by motorists in addition to the state gasoline tax of two cents and the federal tax of one cent.

The repeal action is in line with that of other Missouri municipalities which found that city gasoline taxes produce extremely limited revenue and have the expensive effect of driving general trade to cities which levy no local taxes.

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Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

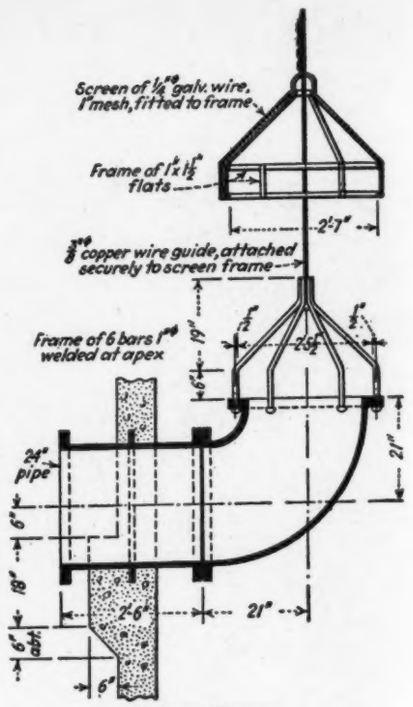
The Water Wheel

Reservoir intakes are provided in the new Fort Smith, Ark., reservoir by upturned 24" elbows set into the wall of the intake tower at three different elevations. These are protected by conical steel galvanized screens, dropped over conical frames and operated by copper cables from the platform of the tower. Gate valves are attached to these intakes at the inside of the wall.[E3-4]

Rainfall and runoff records for Ralston creek, Iowa, were studied and conclusions drawn that "There is some evidence to indicate that the critical depletion period, during which the reservoir storage falls from its maximum to its minimum value, may be from two to five or more years for reservoirs in the central area." For this watershed, "there appears to be a well-defined relation between the rainfall occurring in three or more consecutive years and the corresponding runoff in the same period. This relation should be useful in estimating yields from similar watersheds during the critical depletion periods." Also "the relationship obtained between draft and storage is consistent with the observations on all adequate reservoir supplies and on six of the nine inadequate reservoir supplies in southern Iowa."[A4-3]

Dam stability was increased in Algeria by French engineers by anchoring to the foundation rock. In one case the section of a dam already in service was not thought to be sufficient for safety; in another, the crest had been torn off by a flood, and a new one anchored on. In each case, holes were drilled vertically and steel cables anchored at the bottom, in the former case in bed rock 70 to 80 ft. below the dam foundation. The holes were 10" diameter and 13 ft. apart. The cable consisted of 630 wires of 3/16" in diameter. It was anchored to the rock by cement grout, and the top moored in a concrete block, which was then jacked up until the tension on each cable was 1100 tons and blocked in this position by cast steel chocks. This was equivalent to increasing the weight of the dam by about 84 tons per running foot of crest.[E4-2]

Earth dam foundation for the Quabbin (Mass.) dams was considered so important that a thorough preliminary investigation was made, including 65 deep bore holes and four exploratory reinforced concrete caissons 35 to 45 ft. to bed rock, a maximum of 130 ft. below brook and ground water level. Sinking the caissons was done pneumatically, but as state law limited work under such pressure to 50 lb., or to 18 lb. for 8-hr.-work, water was pumped from inside the caisson after it had been sunk 63 feet. to lower ground water so an external open sump could be sunk for additional use during further sinking of the caisson. Pumping


Screen of ½" galv. wire, ¼" mesh, fitted to frame
Frame of 1" x 1½" flats
2'-7"
⅜" copper wire guide, attached securely to screen frame
Frame of 6 bars 1" welded at apex
24" pipe
21"
2'-6"
6" abt.
6"

Detail of tower inlet and conical screen, Fort Smith, Ark.

Intake and Screen

From Engineering News-Record

continued for a total of 135 weeks, reaching a maximum of 3446 gpm in the 78th week and lowering the ground water level more than 90 ft., so that the maximum air pressure in the caisson was 25 lb. and exceeded 18 lb. for only 2% of the time, while 70% of the sinking was in free air. In the other dam, pumping from two caissons reached 5000gpm.

Data obtained from soil samples and ground water flow gave information which enabled contractors to bid intelligently on sinking cut-off walls to bed rock and therefore reduced cost; also which was used for estimating and checking the permeability of the glacial drift (mostly silts, sands, gravels and boulders) which overlies the bed rock to a depth up to 150 ft. "Accuracy of permability determinations made from the classification of borehole samples depends to a great extent upon the manner in which boreholes are located, on the samples taken and collected, upon the skill with which the field and laboratory work is conducted, and upon the judgment as to the manner in which the various classes of material exist in the overburden," but "the use of ground water pumping to secure a permeability determination is much simpler, provided there is sufficient information regarding the pumping rates, the location of the ground water surface, and the location of the rock valley."[K4-1]

Dispersing copper sulphate in reservoirs by dragging behind a boat in burlap bags is not a very satisfactory method, even when using pea-size crystals in open-mouth bags so that the crystals can be fed uniformly into the bag. Attempts to feed it in solution or sprayed from nozzles have not been satisfactory, for large reservoirs at least. Present methods do not make necessary corrections for temperature, carbonate and bicarbonate alkalinity, organic matter and wind action; the depth to which the copper should be carried should be carefully determined for each treatment; in the old method, before the copper solution can spread over the entire surface, it sinks or forms insoluble com-

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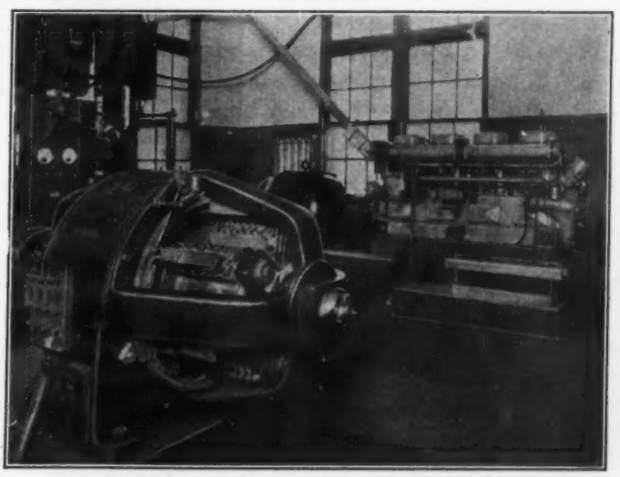

For auxiliary fan drive the Youngstown Sheet & Tube Co., Dehue, W. Va., employs a Sterling Delphin C-8 cylinder 240 H.P. engine direct connected to a 125 KVA Westinghouse generator 60 cycle, 2300 volts. 1200 R.P.M.

Certain fundamentals in design and materials were originally basic knowledge and have been observed all these years. By contrast, lesser knowledge results in engines that are overloaded above 900 R.P.M. How could such overloaded engines serve you reliably, in emergency, when the standby set is the last resort?

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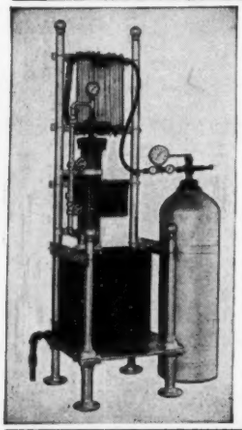


for Water and Sewage Treatment

1 to 100 lbs. of Chlorine per day . . . $375.00 and up

EVERSON *Metered-Feed* **CHLORINATORS**

Here at last is a reasonably priced, accurate, chlorinator that anyone can operate safely.

EVERSON Model G Series Chlorinator offering for the first time: Any delivery from 1 to 100 lbs. of chlorine per 24 hours; Metered-feed; Intimate mixture of gas in water-sealed, self-venting chamber; Protection against back-flooding by an automatic vacuum break, non-corrosion line and values (Guaranteed against corrosion for 1 year) divided into standard replaceable units for safe, easy-cleaning and maintenance; Reliable equipment designed, manufactured and guaranteed by "The Swimming Pool People" specialists in water conditioning for two generations.

Write for Bulletin "G" **EVERSON FILTER CO.** 629½ W. Lake St., Chicago, U. S. A.

When writing, we will appreciate your mentioning PUBLIC WORKS.

pounds which sink, rendering it useless; and the method is very laborious, time consuming, and difficult in rough weather. A new method is to spread the copper sulphate in crystals of uniform size, which depends on the depth it is desired to treat, so that the entire surface is covered uniformly with the exact dose desired. The smallest crystals are used if on the top 3 ft. of water is to be dosed; for 15 ft. depth, crystals passing a 16 mesh screen. Different algae live at different depths. A machine was developed which spreads the crystals from a vertical disc driven 1100 rpm by a half horsepower gasoline motor. The new method, using equipment not so efficient as it theoretically could be, "effects a saving of 63% of the chemical applied, is three times quicker in its application and requires 66% less labor."[A4-1]

Ferric sulphate ("Ferrisul") coagulation at the Providence, R. I., water treatment plant began in June, 1933. Alum had been used until 1932; copperas and chlorine with hydrated lime in 1932 and first half of 1933. The average amount of copperas used in 1932 was 1.03 grains per gallon, with 0.12 gr. of chlorine and 1.02 of lime; in 1935, the average dose was 0.59 gr. of ferric sulphate and 0.94 of lime. With alum, the filter run averaged 28.08 hrs.; with copperas, 68.82 hrs.; and with ferric sulphate in 1935, 88.51 hrs. The average wash water with alum was 2.26% of the total filtered; 2.23% with copperas, and 1.05 with ferric sulphate in 1935. As to the results, the hardness with alum, copperas and ferric sulphate respectively was 19.8, 35.9 and 25.4 ppm. Turbidity, 0.1, 0.1 and 0.0. Iron, 0.06, 0.11 and 0.04. Manganese, 0.15, 0.00 and 0.00. Dissolved oxygen (% saturation) 83, 79 and 68. Total solids, 21, 55 and 47 ppm. B. Coli index, 0.002, 0.002, and 0.001. "The plant effluent is more stable than under any previous treatment." [B2-9]

In Coli-aerogenes identification "Indol production, the Methyl Red and Vosges-Proskauer reactions, and the Citrate test when used together afford the most reliable differential group of tests now in use. It must be remembered, however, that reliable results cannot be obtained with this group of tests unless cultures are purified and, in case of doubtful classifications, purified again until there is no reasonable doubt that an intermediate strain is being dealt with instead of a mixture. The necessity for this amount of purification probably excludes this group of tests from use in the routine laboratory where personnel and equipment are limited." Experience indicates "that direct pour-plate media offer the most promise for the future of coli-aerogenes differentiation. These media will undoubtedly be simplified or new ones developed as in the case of the brilliant green lactose biles agar, whereby they will find their place in the hands of the routine worker and more precise information will be obtainable in a much shorter time than heretofore."[Y3-3]

Diesel engines are used in combination with generator sets for standby power and to furnish current to scattered booster stations, to operate air-lift compressors, and centrifugal pumps through speed increasers. In comparing with other power sources on a cost basis, an 8% depreciation factor on the high first cost is an important factor, offsetting part, at least, of the low fuel cost. Conditions favoring economical operation are: 1—Maintenance of a high load factor over a long period of time. 2—Cheap fuel and lubricating oil. 3—High credit rating of buyers which will enable them to borrow money for installation at a low interest rate. Given fuel oil at 6 cts. a gallon, the operating fuel cost will approximate 0.35 ct. per kwh.[A2-25]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A 4 — *Journal, American Water Works Ass'n*

February

1. New Method of Copper Sulphating Reservoirs. By R. F. Goudey, pp. 163-179.
2. Practical Problems in Water Distribution. By E. W. Breitkreutz, pp. 180-192.
3. Fundamental Hydrologic Considerations for the Design of Impounding Reservoirs in the Middle West. By E. L. Waterman, F. T. Mavis and E. Soucek, pp. 193-206.
4. Obsolescence in Water Works Equipment and Operating Methods. By W. W. Brush, pp. 207-213.
5. Survey of Potential Health Hazards Due to Faulty Plumbing. By W. S. Johnson, pp. 214-233.
6. Back-Siphoning and Cross Connections. By G. E. Arnold, pp. 234-241.
7. Water Supply and Drainage Piping for Hotels. By F. H. Waring, pp. 242-250.
8. Flushing Large Supply Mains in Budapest. By L. Vojcsik, pp. 257-261.
9. Reading and Servicing Meters. By E. Schwarz, pp. 262-265.
10. Well Programs at Missoula and Hamilton, Mont. By H. S. Thane, pp. 266-270.

D 4 — *Surveyor*

February 14

1. Recent Developments in the Treatment of Swimming Bath Water. By R. L. Rankin, pp. 289-291.
2. River Foyle Crossing (Londonderry water main). By W. Criswell, pp. 293-294.

February 21

3. Centrifugal Pumps. By H. H. Stanbridge, pp. 327-328.

February 28

4. *n*. Life of Cast Iron Pipe, p. 354.
5. Centrifugal Pumps. Discussion, pp. 357-358.

E 4 — *Engineering News-Record*

February 20

1. *c*. Subgrader and Concrete Finisher of New Design for Large Canal, pp. 279-282.
2. Shaky Dam Tied Down With Steel Cables, pp. 286-287.

March 12

3. *t*. Design of Reinforcement in Circular Concrete Siphons. By D. B. Gumensky, pp. 380-382.

March 19

4. Pollution Tests for Drinking Water Need Further Investigation, p. 415.
5. Plugging Old Artesian Wells to Stop Underground Water Loss. By T. M. McClure, pp. 425-427.

F 4 — *Water Works Engineering*

March 4

1. Complete Treatment Provided at Rocky Mount, N. C. By P. J. Dishner, pp. 240-243.
2. *p*. Does Grounding Menace Water Supply Systems? By D. W. Johnson, pp. 244-246.
3. *p*. Eliminating the Guess From Anti-Corrosion Treatment. By P. L. McLaughlin, pp. 247-249.
4. Laboratory Control: Tastes and Odors. By C. R. Cox, pp. 253-256.
5. *p*. Water Department Responsibility for House Water Supply Pumping. By S. H. Taylor, pp. 275-276.

G 4 — *Water Works & Sewerage*

February

1. *p*. Some Practical Aspects of Handling Chlorine. By C. F. Bingham, pp. 37-41.
2. Practical Problems in Water Distribution. By E. W. Breitkreutz, pp. 42-45.
3. General Conditions That Affect Profits in Water Works Operation. By C. H. Capen, Jr., pp. 46-47.
4. Dry Feeding Chemicals at Norfolk, Va. By R. W. Fitzgerald, pp. 58-60.
5. *p*. Air Conditioning in Relation to Water Consumption. By L. L. Lewis, pp. 61-63.
6. Evaluating Efficiency in the Purchase of Pumping Equipment. By A. M. Brenneke, p. 67.

J 4 — *American City*

1. *p*. Meter Reading, Billing and Collecting Simplified. By J. C. Houston, Jr., pp. 55-59.
2. Village Water Supply in the Catskills, pp. 73-74.

K 4 — *Proceedings, Am. Soc. of Civil Engineers*

March

1. Permeability Determinations, Quabbin Dams. By S. M. Dore, pp. 299-328.
2. Geologic Features, Quabbin Aqueduct. By F. E. Fahlquist, pp. 329-353.
3. Progress in Water Supply Engineering in 1935. Committee Report, pp. 325-359.

M 4 — *Canadian Engineer*

March 3

1. Reinforced Concrete Pipe Lines at Regina, Sask. By J. W. D. Farrell, pp. 3-8.

P 4 — *Public Works*

March

1. An Elevated Tank with Some Unusual Features, p. 11.
2. Corvallis' Six-Million-Gallon Reservoir. By E. L. Strange, p. 13.
3. Equipment Used in Water Purification, pp. 20-22.
4. Construction Procedure with Small Earth Dams. By W. A. Hardenbergh, pp. 25-26.
5. *n*. Twenty-two-million Acre Watershed Survey, p. 30.
6. Notes on the Use of Activated Carbon in Water Treatment, pp. 41-42.

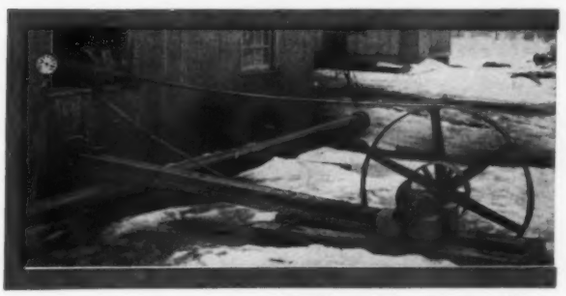
S 4 — *Construction Methods*

March

1. *c*. Job Layout and Equipment for Large Dams. By A. J. Ackerman and C. H. Locher, pp. 44-50.

90,000 POWER HAMMER BLOWS..

15 HOURS OF BRUTAL PUNISHMENT



.....couldn't make this joint leak a drop!

We wanted to find out just what MINERALEAD *would* stand!

So we took two 12 foot lengths of 4" bell and spigot pipe — jointed them with MINERALEAD — and set them to form a span *19 feet between supports*, with the joint centered under the hammer.

The hammer is a simple arrangement—a 4 x 4" beam, secured at one end and actuated by the cam which you see on the near side of the pulley.

For good measure a 50 lb. chunk of iron was bolted to the impact end.

For fifteen hours straight the joint was pounded—100 blows a minute—90,000 separate impacts, each delivering tremendous punishment.

90 lbs. water pressure was maintained throughout the test. At the end of the ordeal the joint was as dry as at the start. Not a *sign* of a leak.

That's the kind of joint MINERALEAD *makes!*

No pipe you lay is likely to ever have to stand such punishment. But you may be quite sure that the jointing compound that can take such rough treatment will not be bothered by any vibration, normal or abnormal, it will meet in service. MINERALEAD means joints that stay tight permanently, under all conditions. That means trouble avoided and money saved.

Want more information? We'll be glad to send it.

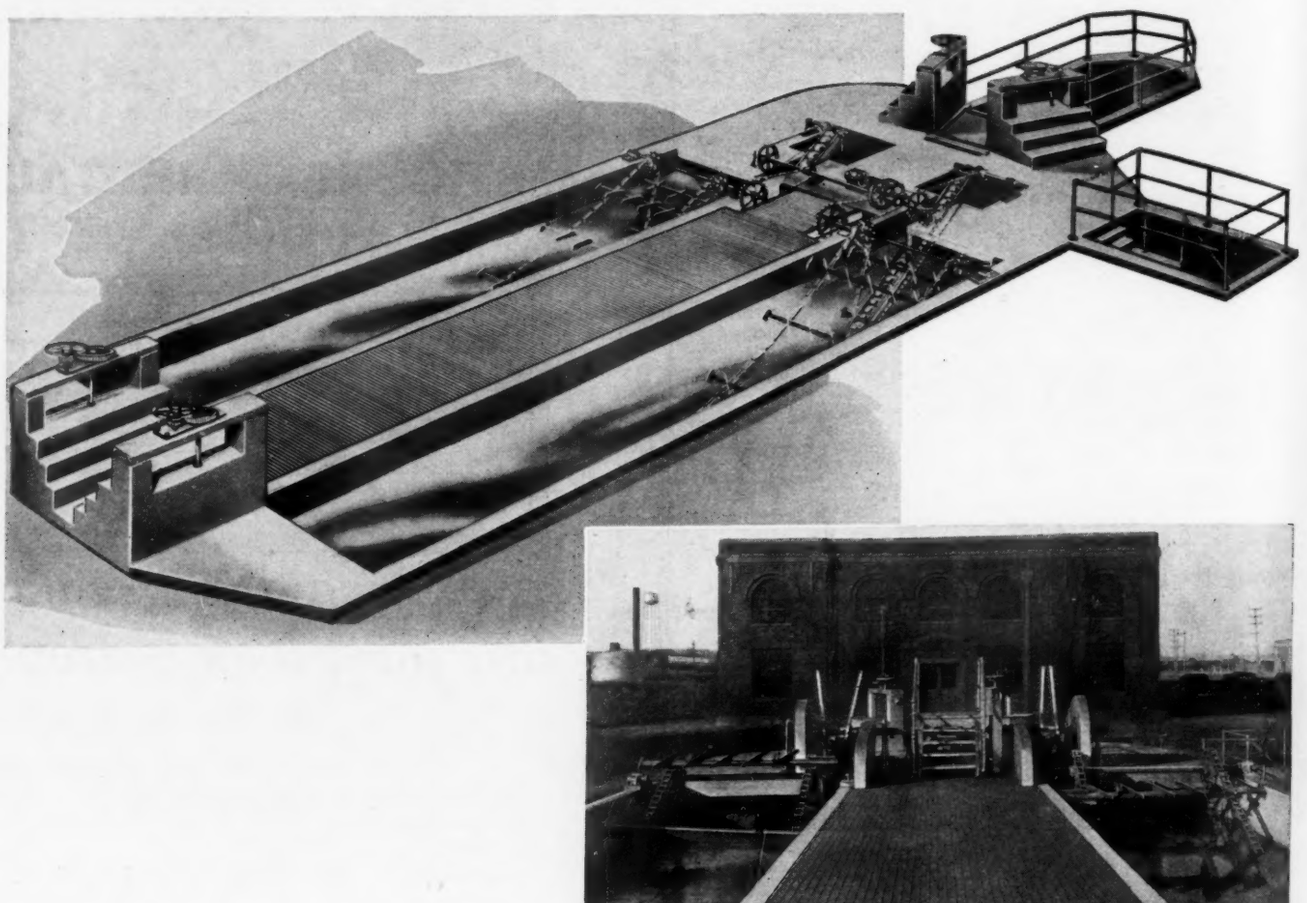
MINERALEAD

***For* Jointing Bell *and* Spigot Pipe**

The
ATLAS MINERAL PRODUCTS COMPANY
of Pennsylvania
MERTZTOWN PENNSYLVANIA

When writing, we will appreciate your mentioning PUBLIC WORKS.

STRAIGHTLINE
Mechanically Cleaned Grit Chamber



KEEPING settling tanks free of sand and grit is effectively and economically accomplished with Link-Belt Straightline grit chambers.

These illustrations show two Link-Belt Straightline chambers installed at the Peoria, Illinois, Sewage Plant (Greely & Hansen, Consulting Engineers). The collectors carry the grit and heavy organic matter to an inclined screw washer. The organic material is separated from the sand and grit by this washer.

Let Us Send You Further Information

LINK-BELT COMPANY

PHILADELPHIA, 2045 West Hunting Park Avenue — CHICAGO, 300 West Pershing Road
SAN FRANCISCO, 400 Paul Ave. — TORONTO, Eastern Ave. & Leslie St. — Offices in Principal Cities

5258

LINK-BELT

SCREENS ▲ COLLECTORS ▲ AERATORS ▲ DISTRIBUTORS

Are you in need of special information? Consult the *classified* READERS' SERVICE DEPT., pages 63-65.

64,000 feet of 31 inch O. D. ⅜" x 30' steel pipe. Department of Water and Power, City of Los Angeles, California. Lined and Coated Barrett Special Water Works Enamel.

Water Works Protective Coatings...the result of 82 years' experience

Since 1854, Barrett has specialized in manufacturing waterproofing products, improving the quality of materials and application technique.

It has successfully developed Coal-tar Pitch Enamels, reinforced with non-absorbent, dielectric micaceous mineral, for exterior and interior linings for steel water lines. These enamels are tough and adhesive, highly resistant to water absorption, soil acids and alkalis. When used as lining in pipe, they increase the co-efficient of flow and prevent tuberculation.

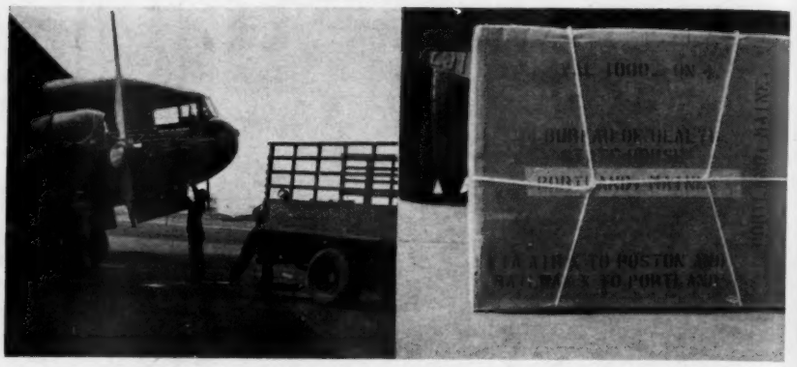
Technical specifications for materials and their application have been carefully prepared. Copies will be sent on request.

Barrett
WATER WORKS
ENAMELS

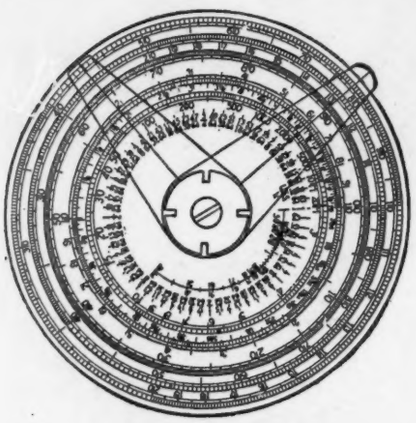
The Barrett Company maintains a Pipe Line Service Department to assist engineers in all coating problems, also has available skilled Field Service men whose assistance is offered where Barrett's protective coatings are used.

THE BARRETT COMPANY, 40 RECTOR STREET, NEW YORK, N. Y.

Of Interest And Value



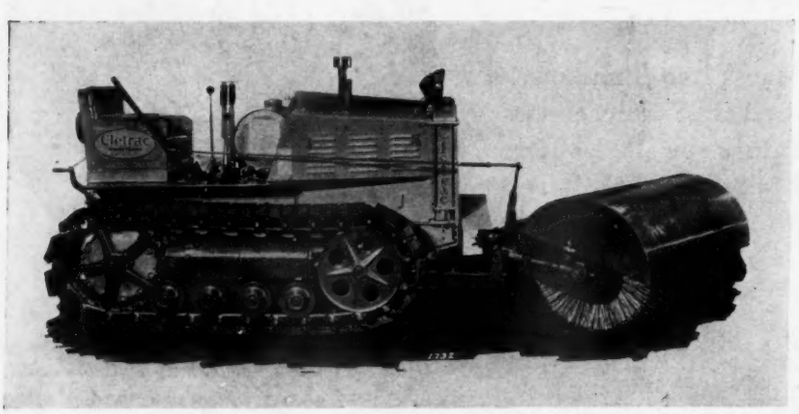
Loading emergency chlorinators into a plane for shipment to the flooded areas of New England. Wallace & Tiernan Co. use airplanes to reach New England, and trucks to carry chlorinators to Pittsburgh and Greensburg, Pa. Service was also extended to the Binghamton, N. Y. area. In all 20 field men were engaged in emergency work in the flood areas.



The midget slide rule shown at the left will do all sorts of computations—even some of our Timewasters. Easy to carry in the pocket. A booklet telling a lot about it will be sent on request to Tavella Sales Co., 25 W. Broadway, N. Y.

The Master Electric Vibrator is another of those snaky devices to produce better concrete construction at a lower cost. Considerable good dope on vibration in catalog sent on request by Master Vibrator Co., Dayton, Ohio.

A technician measures expansion joint material in the Johns-Manville research laboratories, after it has been exposed to moisture. It is shown at the right in its precompressed state. This is a cork material.

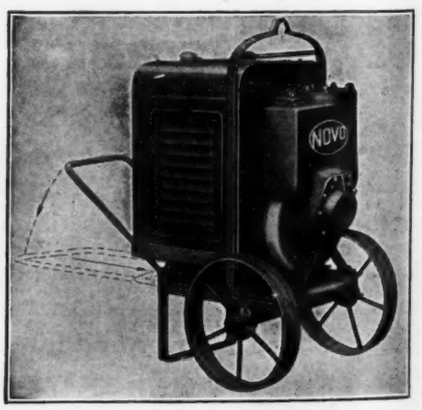


The Model EN Cletrac and revolving broom, manufactured by the Detroit Harvester Company, is particularly valuable during the winter months in cleaning snow from sidewalks, streets and railroad crossings. It is equally effective in sweeping dirt or refuse from factories, yards, shops, warehouses, freight terminals, garages or stockyards. The tractor is 42 inches wide over-all and the broom has a sweeping width of 42 inches. This narrow width permits the operation of this unit in close quarters, where wider equipment could not operate.

Model V Novo Self-Priming Centrifugal Pump

A new line of self-priming centrifugal pumps is announced by the Novo Engine Company, Lansing, Michigan, the Model V. The pump and engine are a unit assembly. The pump case is bolted directly to the engine block. This results in a very compact and economical design. Engines have ample horsepower so that the rated capacity will be delivered under all conditions. A new design of accurately balanced impellers has secured faster priming time.

The Model V pumps will be built in five sizes. They are; 2″ with 3 HP, single cylinder engine, 10,000 GPH; 3″ with 5 HP, single cylinder engine, 18,000 GPH; 3″ with 7 HP, 2-cylinder engine, 24,000 GPH; 4″ 9 HP, 2-cylinder engine, 30,000 GPH; 4″, 15 HP, 4-cylinder engine, 36,000 GPH. All of the above ratings are taken at a 10′ total head.

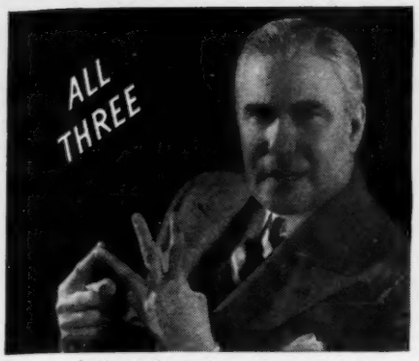


Novo Type V Centrifugal pumps are very compact and have high capacities.

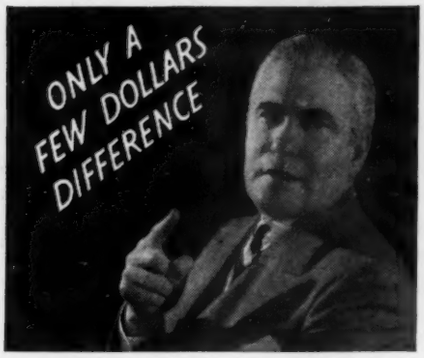
All power units are water cooled and all pumps are equipped with a suction strainer. All engines above the 3 HP are radiator cooled with engine house and are provided with a throttle control.

The compact design has resulted in smaller overall dimensions and a considerable reduction in price.

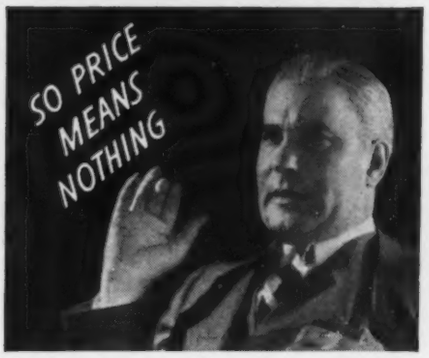
LET'S TALK TRUCK PRICES!



Yes, you just bet it pays to look first at the *price* when you start comparing America's three lowest-priced trucks. Many truck buyers are literally amazed when they see how close together the delivered prices are!

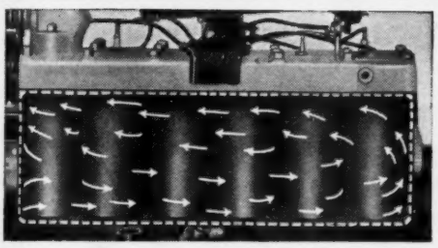


One way or the other, there is only a few dollars difference today between any corresponding models of the three lowest-priced trucks. This is especially true when wheelbase and extra features are considered.



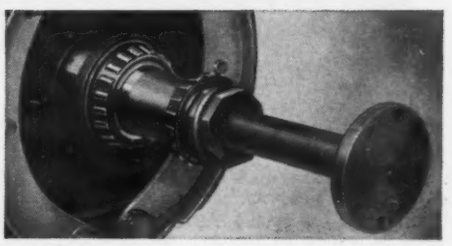
This means one thing sure! You don't need to consider price at all today when you compare lowest-priced trucks. The thing to do is to get a "show-down" on features. Figure what you really *get* for your money.

NOW COMPARE VALUES



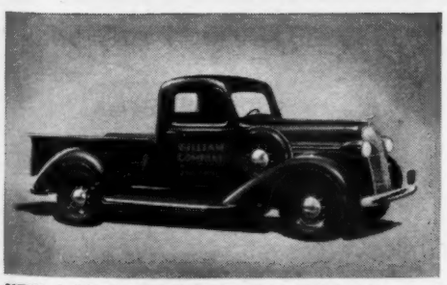
Only one low-priced truck gives you a 6-cylinder, economical L-head engine with exhaust valve seat inserts, full-length water jackets, aluminum alloy pistons, 4 piston rings, spray-cooled exhaust valve seats, oil cooling. That truck is DODGE!

Only one truck of the lowest-priced three gives you hydraulic brakes proved and perfected in many years of actual truck operation. DODGE pioneered this great money-saving feature.



Full-floating rear axle is another of the many quality features pioneered by DODGE in low-priced trucks. DODGE introduced the full-floating rear axle to save upkeep expense for you, make your truck more serviceable and dependable.

SAVE UP TO $95 A YEAR ON GAS ALONE



NEW DODGE COMMERCIAL EXPRESS—116" W. B.—6-cyl.—Fast, easy to handle, dependable. Built to do a lot of work in a day! Has all the famous Dodge quality features to save gas, oil, tires, upkeep... **$500***

NEW DODGE 1½-TON STAKE—136" W. B.—6-cyl.—Gives you 6 special oil and gas saving features, genuine hydraulic brakes, many engineering advancements... yet priced down with the lowest..... **$690***

**List prices at factory, Detroit, subject to change without notice. Special equipment, including dual wheels on 1½-ton, extra.*

• • •

Through the Official Chrysler Motors Commercial Credit Company New 6% Time Payment Plan, you will find it easy and economical to arrange time payments to fit your budget.

REPORTS from users of new Dodge trucks indicate savings on gas alone of up to $95 a year. Extra savings on oil, tires and upkeep are just as sensational. Dodge gives you new "Fore-point" load distribution to increase hauling efficiency ... dozens of extra-quality features like safety-steel cab and 4-bearing crankshaft that make your truck last longer, make it a better investment. When your Dodge dealer urges you to get a "show-down" of Dodge against the others, he has in mind all the cost-cutting advantages that Dodge alone gives you. He especially invites you to make the free prove-it-yourself gasometer test. Get the facts. See your Dodge dealer today!

DODGE DIVISION OF CHRYSLER CORPORATION

Dependable **DODGE TRUCKS**

STILL PRICED WITH THE LOWEST

$370*

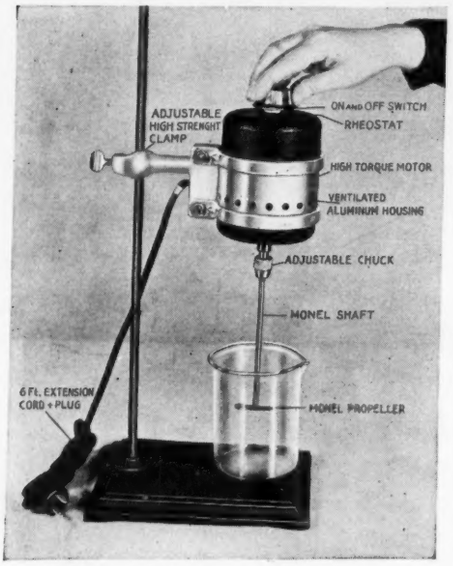
½-TON CHASSIS, 116" W. B.

Are you in need of special information? Consult the *classified* READERS' SERVICE DEPT., pages 63-65.

For Field and Laboratory

Lab-Mix, Sr.

To provide a more powerful, variable speed, low priced, non-sparking laboratory stirrer, the Lab-Mix, Sr. has been evolved. Actuated by a shaded pole type motor, it will run hours daily without damage. It can be used only on 110 volts (50-60 cycle) A. C. Since it is non-sparking, there is no danger of explosion when mixing inflammable liquids, such as alcohol, benzol, etc. The speed may be varied by the rheostat. There is an off position on the rheostat which serves as an on and off switch.



Very handy and low in price

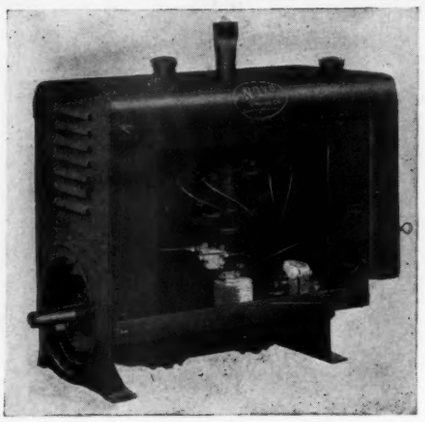
It is provided with a screw clamp which fits any ring stand. The shaft and propeller are made of Monel. The pitch of the propeller may be changed with pliers to regulate mixing. A flexible, 6 foot cord and plug are included so that it may be plugged into any outlet. Write for dope. Chemical Pub. Co. of N. Y., Inc., 175 Fifth Avenue, New York, N. Y.

Hi-Dumper Double Acting Hydraulic Hoist:

The new model 66 St. Paul "Hi-Dumper" hydraulic hoist designed for all 1½- to 2-ton trucks is designed to raise the maximum load beyond the vertical position, thus providing instantaneous dumping of load. A 77 degree dumping angle is attained.

When the load is dumped the body is returned to the normal position by the hoist which pulls it back by hydraulic action or gravity. Valve in locked position makes it possible to instantly lock the body in any position. This comes in handy when spreading the load over a road bed.

Write St. Paul Hydraulic Hoist Co., Minneapolis, Minn., for complete dope.



Novo Model C industrial engine

Novo 2 and 4-Cylinder Model C Engines

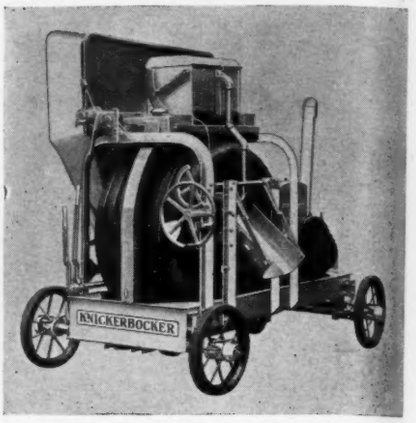
The Novo Engine Company, Lansing, Michigan, announce a line of industrial engines, known as the "C" models. This line will at first be composed of two 2-cylinder engines, 2¾ x 4 and 3¼ x 4; and two 4-cylinder engines, 2¾ x 4 and 3¼ x 4. Cooling is radiator with thermo-syphon circulation, although water pump circulation may be added. The crank shafts and cam shaft are equipped with ball bearings. These engines are equipped with battery ignition when electric starter and generator are specified.

Engine Circular No. 355 is available giving full description of these power units.

New Knickerbocker Mixer

The average contractor wants to mix good concrete, at a speed that will result in a profit on each cubic yard placed. The engineer requires that each batch turned out shall have a given quality, no matter what the time of mixing. Working with construction engineers and with contractors, the Knickerbocker Company, Jackson, Michigan, has sought to design a mixer that would satisfy the demands of both contractor and engineer for quality concrete and the particular demands of the contractor for speed.

The high lift of the St. Paul

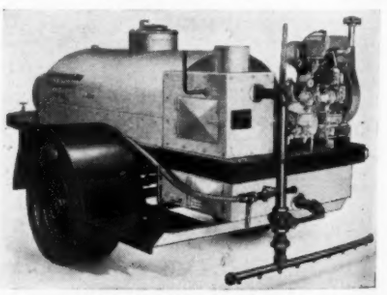


Knickerbocker 7-S with 60° loader pitch

The low center of gravity of the Knickerbocker mixers give them greater stability, make them safer to transport. They are made in five sizes, 5, 7, 10, 14 and 28-ft. capacities, are equipped with calibrated, non-pressure, syphon-type water measuring tanks, are available with a variety of wheel and tire equipments.

Littleford Utility Sprayer:

The Littleford No. 101 Sprayer, a highway maintenance outfit, has been on the market since 1928. Made in sizes from 300 to 800 gallons capacity, the outfit is usually mounted on pneumatic tired trailers. It is equipped with an air cooled engine and rotary pump. One or two oil burners with U-type return heat flues serve as a heating system. A pressure pump is used to supply fuel for burners.

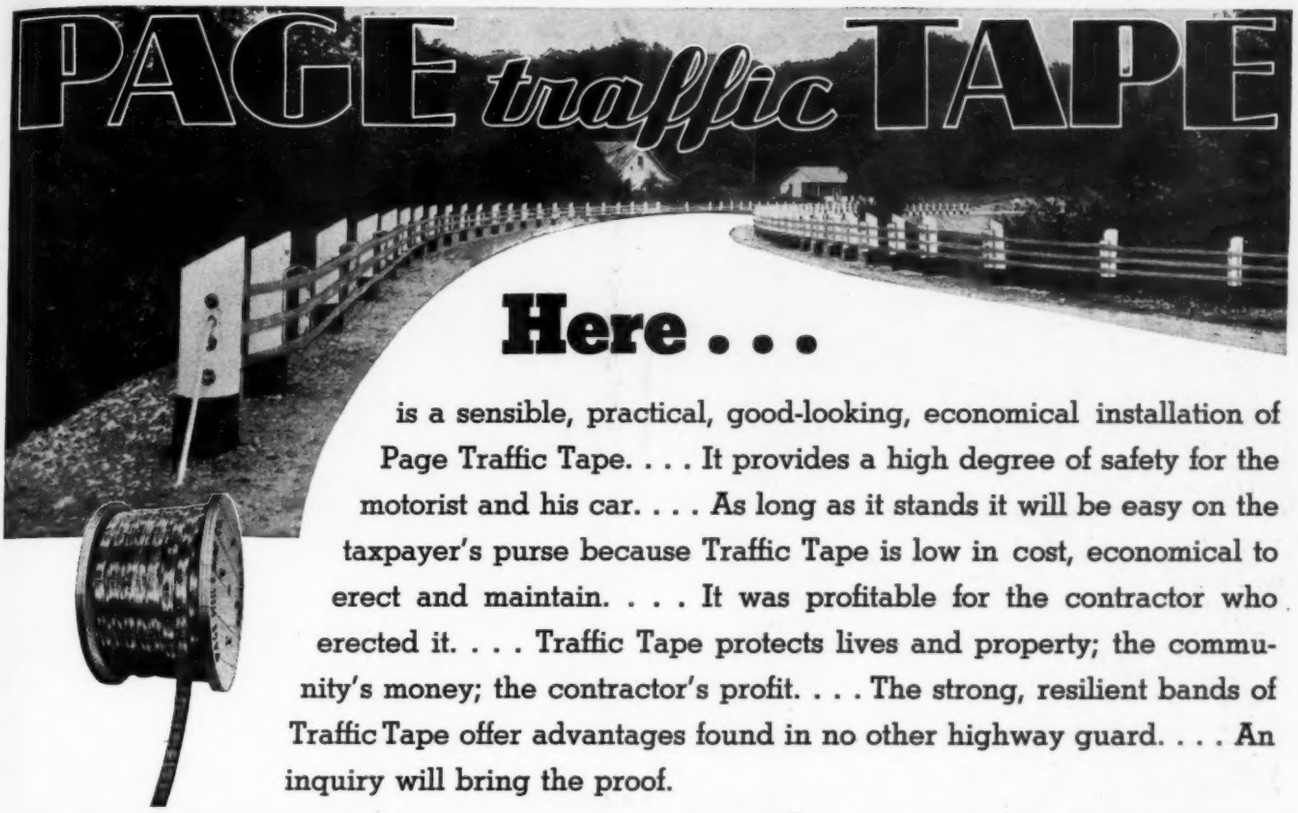


The Littleford Utility Sprayer

The No. 101 has the advantage of enabling users to handle tars, asphalt, emulsions, cut-back or road oils directly from bulk storage or tank car, eliminating package material. You can operate as many hand spray bars as desired with control valves on spray bar handles. It has a draw-off cock for filling pots. An auxiliary four-foot spray bar can be used for applying bitumen when widening shoulders or relocating curves. This man sized outfit can be used to advantage for skin patch maintenance jobs or shoulder stabilization, where a pressure distributor would be too large and unwieldy.

Descriptive literature, prices and full information can be obtained by writing Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.

PAGE *traffic* TAPE



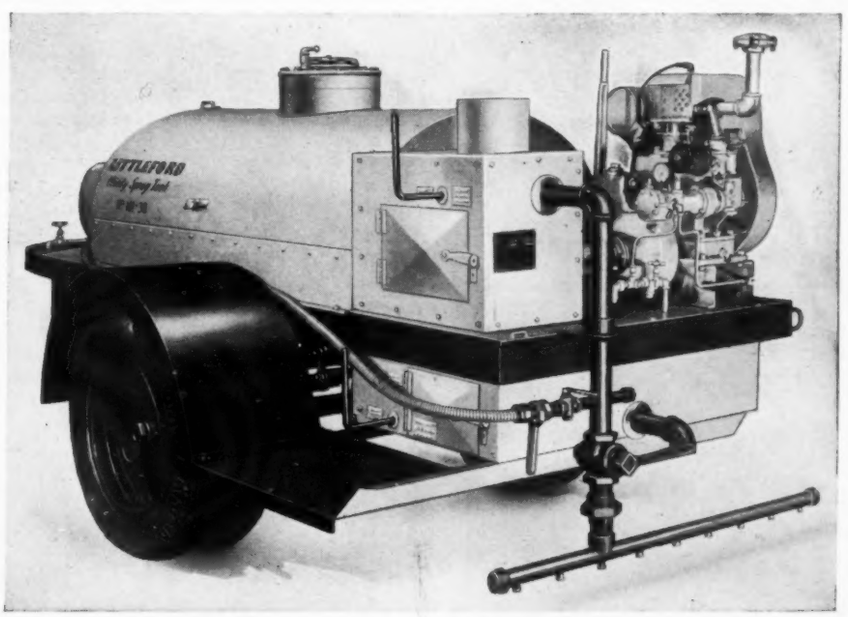
Here . . .

is a sensible, practical, good-looking, economical installation of Page Traffic Tape. . . . It provides a high degree of safety for the motorist and his car. . . . As long as it stands it will be easy on the taxpayer's purse because Traffic Tape is low in cost, economical to erect and maintain. . . . It was profitable for the contractor who erected it. . . . Traffic Tape protects lives and property; the community's money; the contractor's profit. . . . The strong, resilient bands of Traffic Tape offer advantages found in no other highway guard. . . . An inquiry will bring the proof.

PAGE STEEL & WIRE DIVISION OF THE AMERICAN CHAIN COMPANY, INC., MONESSEN, PENNSYLVANIA

District Offices: New York, Pittsburgh, Atlanta, Chicago, San Francisco

In Business for Your Safety



THE LITTLEFORD NO. 101 UTILITY SPRAYER

● Handle your bituminous materials in bulk. Save on cost of material and handling time. Littleford No. 101 Units are made in stock sizes from 300 to 1200 gallons capacity. Write for prices and information on how this unit can benefit you.

THE SIGN OF A GOOD HEATER — LB — LITTLEFORD BROS. CINCINNATI, OHIO

LITTLEFORD

Road Maintenance Equipment

SINCE 1900

LITTLEFORD BROS. 452 E. PEARL ST. CINCINNATI, O.

New Equipment for the Engineer

The Aeroflocculator for Chemical Treatment

You cannot get efficient coagulation without proper mixing and flocculation of the chemical. The "Aeroflocculator" employs a new idea to accomplish this. Proper mixing and flocculation of the chemical with sewage or with water is assured. Among the advantages which are claimed for its use in the chemical treatment of sewage are:

It mixes the incoming raw sewage with previously flocculated sewage, furnishing a base to which the newly-forming floc may adhere.

There is a positive control of the ratio of returned flocculated sewage to the incoming raw sewage.

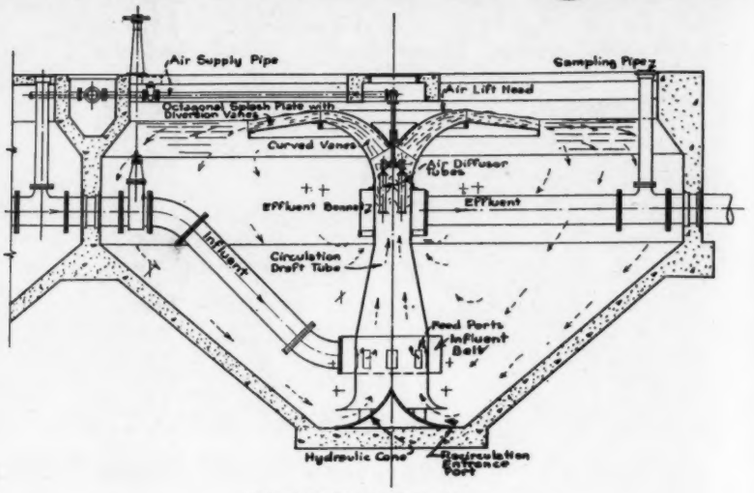
Means for continuous recirculation of the mixture of raw sewage and flocculated sewage to absorb and coagulate the colloidal substances are provided.

Diffused compressed air is used for treatment of the circulated sewage.

Partial aeration by diffused air and atmospheric air absorption with the consequent release of undesirable gases and the maintenance of the coagulant in an oxidized condition.

The aeroflocculator permits the use of inexpensive coagulating chemicals which require oxidation for their conversion to ferric hydroxide. It also has the advantage that there is a complete absence of moving parts and no opportunity for short-circuiting in the tank.

It would seem that this mixer has also the very important quality that it provides a flexibiliy to meet the demands of various types of sewages—highly desirable in chemical sewage treatment.



"Municipal" aeroflocculator.

A Useful and Accurate Machine:

A new fine grader and shoulder machine has been developed by A. W. French, 8524 Vincennes Avenue, Chicago, Illinois. This machine, known as the French Utility Grader, completes the work of subgrading, formgrading, shoulder-grading, stripping, leveling and material loading.

The Grader operates on its own crawler tracks, and so eliminates the use of road forms when cutting subgrade on road construction. It cuts an accurate grade to any crown or surface desired, the grade being controlled by a leveling frame which is adjusted to a line set from the engineer's grade stakes. It can handle cuts up to seven inches and on subgrade work cuts not only the subgrade but the formgrade at one passage of the machine. Material taken from the subgrade can be either loaded into trucks, for placing where needed, or spilled along the shoulder.

This machine is built in but one size, cutting thirteen feet wide in one passage of the machine. When used on wider pavements, two or more passes are made, thus allowing trucks plenty of clearance to pass the grader.

New Littleford Pressure Distributor:

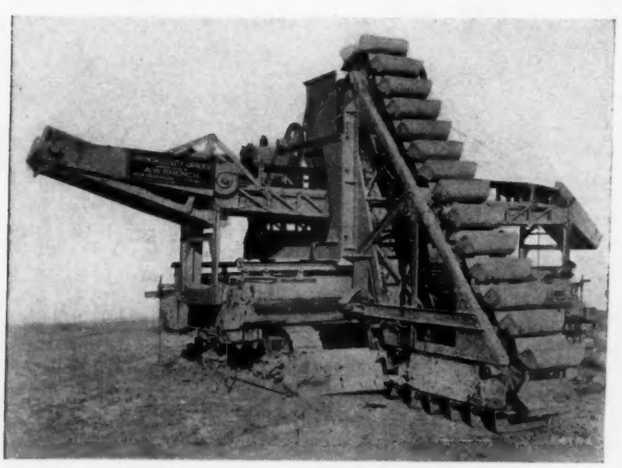
The Littleford Model "C" pressure distributor has been on the market since 1930. The improved Model "C" represents the same distributor with several refinements. A new larger Viking positive pressure pump with 4″ inlet and outlet connections is now used. The four-position valve, while remaining basically the same, has been improved and provided with 4″ openings to correspond to pump. This one valve entirely controls the entire operation of the distributor and is actuated by a handwheel.

A new type of fifth wheel drive for truck tachometer has been designed. It has a 16″ x 4″ pneumatic tired wheel with angle type drive (having no exposed gears). It is impossible for stones and bitumen to interfere with it. A tachometer on pump is standard equipment.

A new alloy that is especially heat resistant has been used in the combustion tube. The continuous heat flue which heats material very quickly and efficiently is an important feature. An air cleaner on air blower is now used. A new type of clutch on blower and fuel pump drive has been designed. All pipe connections are either flanged or welded.

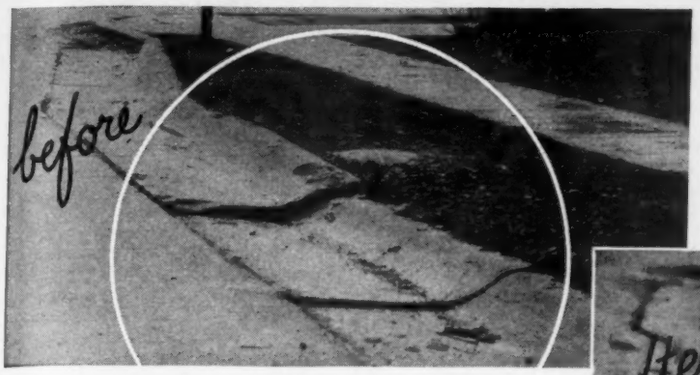
Since accuracy of application and the necessity of instant shut-off of spray bars has become such a big feature in the design of pressure distributors, no effort has been spared to guarantee the utmost along these lines.

Full information, literature and prices may be obtained from Littleford Bros., 453 E. Pearl Street, Cincinnati, Ohio.



Above, the Littleford pressure distributor, which is an improved model of the original Model C. At the left is the A. W. French utility grader. This machine has a wide range of usefulness for fine grading and shoulder work. Both these machines are described more fully in the text on this page.

MUD-JACK METHOD
for raising concrete curb · gutter · walks · street



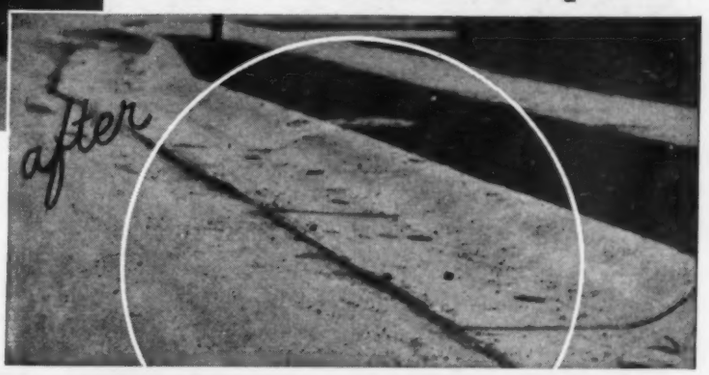
Sunken Curb and Gutter Marked for Reconstruction

but

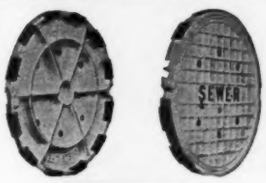
THE MUD-JACK METHOD *corrected the settlement and saved the reconstruction costs*

Save CURB — GUTTER
WALKS — STREETS

The Mud-Jack method saves the slab —corrects the subgrade—eliminates pedestrian hazards. Write for data to reduce maintenance expense.



KOEHRING COMPANY
Pavers · Mixers · Shovels · Cranes
Draglines · Dumptors · Mud-Jacks
3026 WEST CONCORDIA AVE. MILWAUKEE, WISCONSIN



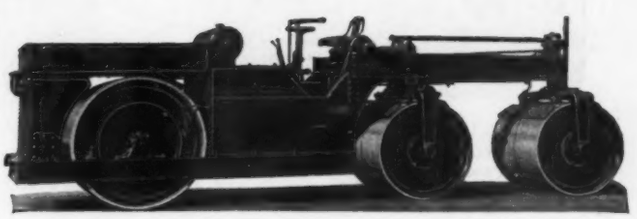
RUBBERIZED COVER

We welcome an opportunity to quote on your requirements.

Safety First!
BUILD WITH STEEL CASTINGS

Manhole Covers
Catch Basin Grates
Curb Inlets
Monument Boxes
Manhole Steps and other Steel Castings

NOISELESS, DURABLE HIGHWAY CASTINGS
THE WEST STEEL CASTING CO.
CLEVELAND, OHIO



The New Buffalo-Springfield 3-Axle Rollers
for all kinds of precision rolling especially of bituminous materials either hot or cold.

THIS new type of Roller (Patented) introduces the new principle of automatic compression and leveling, and retains the advantages of large diameter in all rolls. The entire roller is steerable with all rolls in permanent contact with the surface material thereby giving multiple compaction at all times.

An illustrated pamphlet is available and will be sent upon request.

The Buffalo-Springfield Roller Company
SPRINGFIELD, OHIO

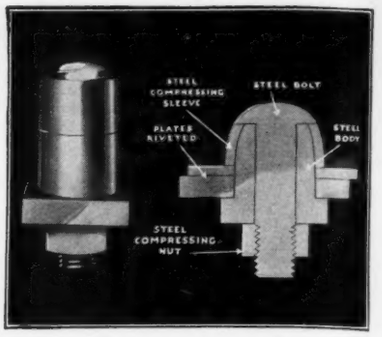
CONCRETE VIBRATORS Air operated vibrators for all classes of concrete construction including Bridge deck slabs, Dams and Locks, Highway pavement and Concrete products.

WRITE FOR CIRCULARS AND ENGINEERING DATA

MUNSELL CONCRETE VIBRATORS
TEANECK NEW JERSEY

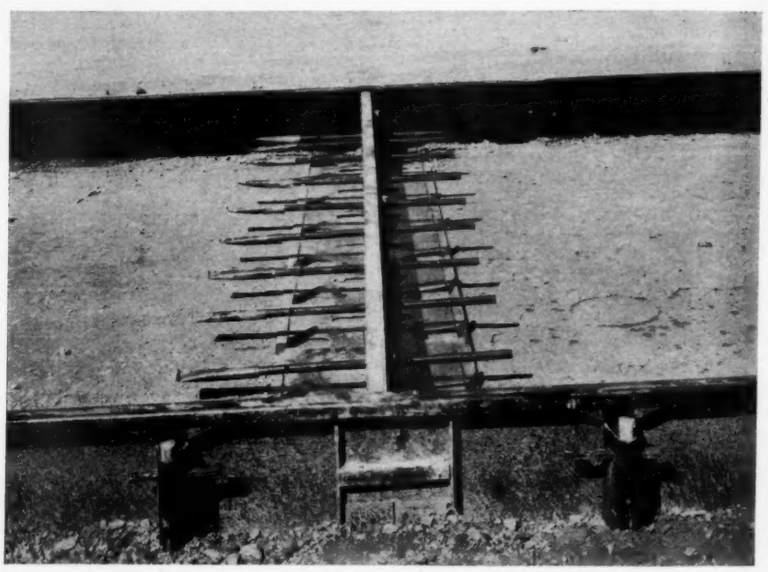
News and Equipment Pictures

Above: Photo by Ellis K. Phelps of the Totowa, N. J., sewage treatment plant during recent high water on the Passaic River. This picture, taken with a postage stamp sized camera, shows at the left the trickling filters (under a glass cover), and center, the sludge drying beds, also glass covered, which were inundated.

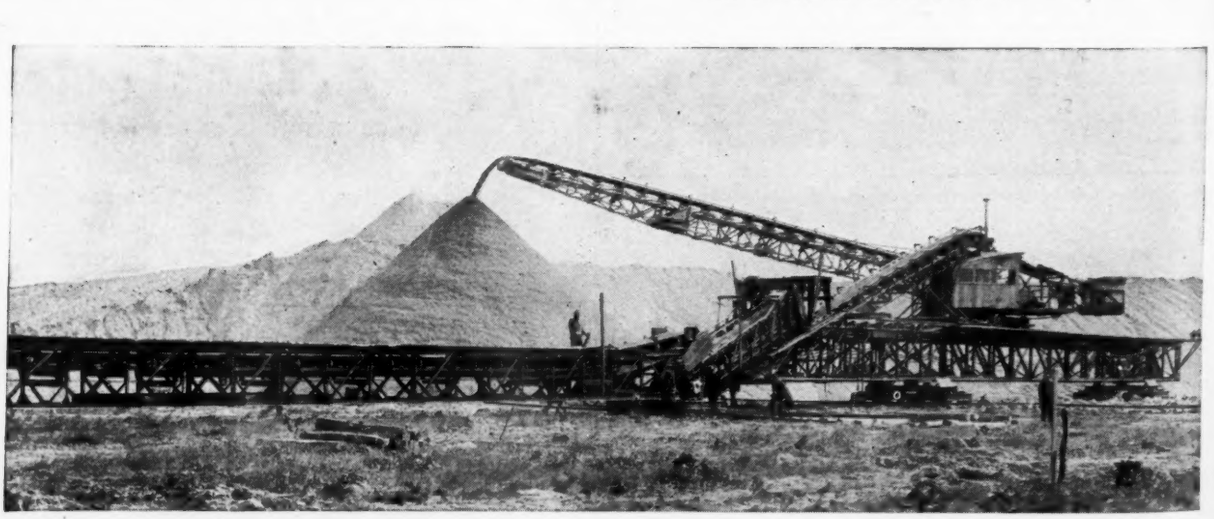


This shows the anatomical structure of a mechanical rivet which can be inserted and set from one side. Right handy in tunnel and similar work where all work must be done from the inside looking out. Excellent for placing patch-plates on tanks, etc. Write Multi-Seal Co., 123 N. Jefferson St., Chicago, Ill.

One of the Link-Belt K-48 electrically driven 2½-yard crawler dragline delivering dirt to the belt-conveyor. Stacker in distance. Dragline has an operating cycle of 22 seconds.



The Wheeling dowel and joint support for concrete road construction is an economy. The makers say one man can install a complete joint in about 3 minutes. A nice red-white-blue folder is available with plenty of cost dope and data. Write Wheeling Corrugating Co., Wheeling, W. Va.



The dream of generations—the Florida Ship Canal—develops new methods of dirt-moving and dirt-handling. An 85-ft. Link-Belt "Stacker," fed by an L-B belt-conveyor, finishes the top of the spoil bank. Some 12,000 cubic yards a day are handled. The Harvey-Ray-Noonan Constr. Co., who have this section of the job, will handle about 2,000,000 cubic yards. The complete job will involve more than 550 million cubic yards of excavation and will cost an estimated $146 million—if and when finished.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 64

pression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

411. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control

412. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Protective Pipe Coating

413. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines

414. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Rubber Lined Pipes and Pumps

415. New, 68-page catalog describes Ace rubber lined pipe and fittings, hard or soft rubber lined centrifugal pumps and Ace hard rubber double acting pumps, for chemicals used in treating sewage and water and for acids and other corrosive liquids. Contains illustrations and specifications. Issued by American Hard Rubber Co., 11 Mercer St., New York, N. Y.

Runoff & Stream-Flow

416. Technical information on measuring run-off, both from small areas, for storm sewer design, and from large areas for determining water-shed yield, and instruments for measuring. Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill. Book 642.

Rainfall Measurement

419. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

420. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Bed Glass Covers

422. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Elizabeth, N. J. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Drying

424. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

Sludge Incineration

427. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

428. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Sludge Removal Equipment

429. If you are interested in economical sludge removal, write for the latest bulletin describing and illustrating Louden Monorail equipment which is adapted to open or closed beds. Full details sent promptly by the Louden Machinery Co., 400 West Ave., Fairfield, Iowa.

Swimming Pool Equipment

430. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 625 W. Lake St., Chicago, Ill.

431. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

432. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

433. Installation views and considerable engineering data including capacity tables for settling tanks and layouts of typical arrangements for both final and primary tanks, are contained in a new booklet—No. 1542—just published for engineers by Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill.

436. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

438. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

441. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill., and Philadelphia.

442. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 247 Park Ave., New York, N. Y.

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For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Chemical Precipitation:

In all chemical treatment plants, efficient flocculation of the chemical is necessary. In this 16-page booklet, the fundamental principles of flocculation are given, along with very recent data on design. While this is written around the "Aeroflocculator" which is manufactured by the Municipal Sanitary Service Corp., 155 East 44th St., N. Y., it contains a lot of first-class dope. Design data are given; also construction and operating data; plans and sketches complete the information. Well worth your while. Write William Raisch, at the above address, for a copy. No cost.

Repairing Flood Damage:

Farmers' Bulletins published by the U. S. Department of Agriculture give many practical suggestions to make the clean-up and rehabilitation jobs easier. These will be issued free in reasonable number as long as the supply lasts, and can be ordered from the Superintendent of Documents, Washington, D. C., at 5 cents a copy:

1219-F—Floors and Floor Coverings.
1474-F—Stain Removal.
1227-F—Sewerage of Farm Homes.
1448-F—Farmstead Water Supply.
1426-F—Farm Plumbing.
1480-F—Small Concrete Construction.
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1751-F—Roof Coverings.
1570-F — Mosquito Remedies and Preventives.
101-L—Injury to Buildings by Termites.
1234-F—Gullies: Control and Reclamation.
77-L—Bracing Farm Buildings.
1087-F—Beautifying the Farmstead.

Note for the Field Engineer:

Biologists of the U. S. Department of Agriculture tell us that rattles are just what baby rattlesnakes do not have. Instead, a newborn rattler must be content with just a button—on the end of its tail. Only after twice shedding its skin, a few days after birth and about two months later, is the first ring of the rattle formed.

The power of the rattle seems dependent upon the fact that the last 7 or 8 of the snake's vertebrae early fuse into a solid bone, the "shaker," around which the rings of the rattle form. Normally one ring is added to the rattle every time the snake sheds its skin, which is usually three times a year. According to biologists, a small number of rings is more an indication of a snake's tail-wagging proclivities than its youthfulness. In other words rings are shaken or broken off by the vigor of the tail's movements. What is more, it is believed that nature gave the snake his rattle not as a warning device, but to be used as a call or a challenge during the breeding season. However that may be, it does serve as a highly effective "keep off the grass" and saves the snakes a lot of bother.—*Journal of Franklin Institute.*

Truck and Trailer Laws:

The 1936 edition of the complete and handy booklet giving in detail the laws of each state regulating the size and weight of trucks and trailers. One page is devoted to each state. Data as of Jan. 1, 1936. Sent on request, without obligation. Write Four-Wheel Drive Auto Co., Clintonville, Wisc., attention K. W. Sinninger, who will send a copy promptly.

Plant Mixing for Stabilized Roads:

This bulletin will give you a good groundwork of information on the latest in low-cost road construction—stabilization with a plant to mix the soils and aggregates. This does away with the difficulties of mixing in place on the road. Ask for Bulletin 24, Calcium Chloride Association, Penobscot Bldg., Detroit, Mich.

Curbs, Gutters and Sidewalks:

This is a catalog, but good enough in general information on how to build curbs, gutters and sidewalks — meanwhile stressing the types of forms to use—that its handy to have in your file. Mostly pictorial, but the pictures tell a story. Sent on request to Heltzel Steel Form & Iron Co., Warren, Ohio.

Slaying Bacteria:

The Katadyn process of sterilizing water by means of a silver solution is explained in several booklets and folders which will be sent on request. Considerable information on the application of this process to swimming pools. Write Katadyn Process Corp., 45 West 45th St., New York.

Bronze-Welding:

A pretty complete booklet of 12 pages summarizing the available information on bronze-welding and bronze-surfacing. Step-by-step procedures are given. Copy on request from Linde Air Products Co., 205 East 42nd St., New York, N. Y.

Air Compressor Lubrication:

Good and complete information on the lubrication of air compressors and the engines that drive them. Ask for "Lubrication" for November, 1935. No charge, we believe. Texas Co., 135 East 42nd St., New York.

Concrete Curing:

Contains condensed new, interesting and authoritative data from such sources as Bureau of Standards, Portland Cement Ass'n, and Bureau of Public Roads, plus their own experiences of many years. Covers such matters as increasing workability, controlling temperature, proper moisture for complete hydration, etc. Graphs, charts and tables. Write George H. Kimber, Solvay Sales Corp., 40 Rector St., New York, N. Y., for copy. No obligation.

Petroleum Taxation:

An interesting text covering diversion, tax evasion, exemptions and refunds, how much these taxes amount to, where they go and how they are spent. 24 pages. You can get a copy by writing the American Petroleum Industries Committee, 50 West 50th St., New York, N. Y.

The Steadyflow Traffic System:

By the late Fritz Malcher. Volume IX of the Harvard City Planning Studies. Mr. Malcher's poposals for a system of traffic regulation through street design have aroused wide interest. City planners, traffic engineers, highway officials, and those who must deal with the universal and ever-growing traffic problem will welcome this first comprehensive presentation of Mr. Malcher's distinctive solution to it. By abundant illustrations as well as its text, this book sets forth the fundamentals of street design, the economic aspects, and the application to existing traffic problems of a system which would completely eliminate right-angled intersections of traffic from our streets and highways.

Fred Stuart With Activated Alum Corp.:

Fred E. Stuart has resigned as supervisor of water purification for the Industrial Chemical Sales Corp., which position he has held since 1931. He will become president and development engineer of the Activated Alum Corp., a newly-formed organization with offices at 80 Broad St., New York City, which will distribute activated alum, a combination of alum and activated carbon. This product is adaptable for use in both water and sewage treatment and is of especial value where taste and odor troubles occur. Mr. Stuart, who is very well known in the water purification field, was educated at the University of Alabama and Stetson University, where he took special work in water purification. Before coming with the Industrial Chemical Sales Corp., he was, for 8 years, with the Daytona Beach, Fla., water department.

W. L. Baumgartner, who has been developing uses for copperas in the water and sewage treatment fields, has been transferred from the Krebs Paint and Pigment Co., Newark, N. J., to the Grasselli Chemical Co., Cleveland, Ohio.